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ABSTRACT

A site in Milwaukee was selected for a series of high-risk population survey. This area was rated in the lowest category for Milwaukee in terms of median educational level and income, and in the highest in terms of population density per living unit, percent housing rated as dilapidated, and unemployment. A pool of candidates composed of mothers with full-scale Wechslar Adult Intelligence Test IQs of 75 or less was randomly assigned to either the experimental or control condition. Forty mothers meeting this IQ criterion had babies over an 18 month period and were assigned as either experimental or control families. All families selected were of Negro extraction. The experimental intervention is comprised of two components: the infant stimulation program, and the maternal rehabilitation program. The former program is designed to facilitate intellectual development of very young children. The plan is concerned with a staff to manage and arrange instruction for children, a physical location which promotes learning, and the stimulation program. The latter program was initiated to better prepare the experimental mothers for employment opportunities and to improve their homemaking to teach the mothers basic academic tools necessary for vocational adaptability and an occupational training program to teach specific vocational skills. (Author/JM)

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REHABILITATION OF FAMILIES
AT RISK FOR MENTAL RETARDATION

A PROGRESS REPORT

October, 1971

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I

INTRODUCTION

The Family Rehabilitation Research Program represents an attempt to mitigate or prevent intellectual deficits in "high-risk" children by comprehensive family intervention. The research design is intended to contribute to our understanding of the determinants of "cultural-familial" mental retardation. Over the past thirty years, no issue in the field has generated more intense, bitter controversy than that concerning the etiology of cultural-familial mental retardation. Nationwide interest in this question is particularly acute at the present time as a result of widespread public and professional recognition that this kind of retardation is almost exclusively found among economically depressed population groups and that those minority groups disproportionately represented in disadvantaged populations yield a particularly high prevalence. Certainly, in view of the fact that approximately 80% of mental retardation is attributed to be "cultural-familial", achievement of a more adequate understanding of etiological factors in cultural-familial mental retardation is of utmost practical concern.

Although there has been no adequate national survey of the prevalence of mental retardation in this country, it is generally accepted that, as a rule of thumb, one may consider about three percent of the population to be identifiable as mentally retarded. In about 80 percent of this group there is no identifiable gross pathology of the central nervous system. It is this group, without identifiable pathology of the central nervous system, which is almost exclusively found among the populations of economically depressed urban and rural areas. Because of this relationship, this group is often referred to as the "cultural-familial" mentally retarded.

The nature of mental retardation is, of course, a function of an entirely arbitrary definition. The concept has varied between societies as a function of differences in technological sophistication and in social philosophy, and has varied over time as a function of technological and social changes within a given society. The concept has varied between scientific and professional disciplines as a function of their particular biases.

The most nearly universal contemporary definition of mental retardation in the United States requires that a suspicion of mental retardation established on the basis of measured intelligence be confirmed by clinical judgment of the adequacy of the individual's actual adaptive behavior.

Measured intelligence greater than one standard deviation below the mean (a statistical term which expresses the dispersion of scores in the standardization sample) is arbitrarily set as the cutoff point for consideration of possible retardation. This cutoff point is equivalent to a test score of about IQ 84 on the most commonly used individual tests of general intelligence.

Only a small proportion of persons near the cutoff point are actually diagnosed as being mentally retarded inasmuch as their adaptive behavior is not called into question. As measured intelligence becomes lower, increasing percentages of persons falling in that intelligence range are identified as mentally retarded.

In actual practice, in the United States, individuals with measured intelligence at two standard deviations or more below the mean (about IQ 70 for most individual tests of intelligence) are classified as being retarded on the basis of their IQ scores alone. An IQ level of about 75 and below would include very close to 100 percent of all individuals in the United States who are identified and treated as mentally retarded.

There are literally scores of specific diseases and conditions which have been known to produce damage to the brain and eventuate in retardation. These can be grouped in the following categories:

1. Infections which involve the central nervous system of the infant or young child.
2. Physical injuries to the brain before, during, or after birth.
3. An array of disorders of metabolism, some of which are genetically determined, which damage the nervous system.
4. Conditions of genetic or unknown cause which involve abnormal growths within the brain.
5. Diseases of genetic or unknown origin which result in a progressive degeneration of the central nervous system.
6. An array of prenatally determined conditions which involve physical defects of the brain or which present distinctive physical characteristics.

Estimates are that no more than 20 percent of the total population of mentally retarded present demonstrable pathology in the structure or functioning of the central nervous system. This type of retardation, in which pathology of the central system is a presenting feature, is fairly evenly distributed throughout all socioeconomic, ethnic, and racial groups. Furthermore, it is generally, although not always, associated with measured intelligence greater than three standard deviations below the mean (or less than IQ 55 on the major tests). Affected persons tend to function either as trainable or nontrainable pupils in school, or as profoundly or severely impaired in adaptive behavior in adult life. They are also likely to have associated secondary physical disabilities.

By contrast, the remaining 80 percent of all mental retardates do not present obvious gross pathology of the central nervous system and it is this group which is designated as "cultural-familial" mentally retarded. A small number from among this group appear retarded because of long-standing emotional or psychotic disorders of childhood which have interfered with learning. A few may be retarded because of a disability, such as impaired vision or hearing, or cerebral palsy, which has resulted in a restriction of learning opportunities essential to normal intellectual development. The great proportion of this group, however, are persons who appear quite normal in the physical sense; they simply function as mentally retarded.

The basic cause of this type of retardation is unknown. Factors of inheritance of intelligence have been implicated. Inadequate prenatal care among low socioeconomic group mothers, high rates of prematurity, and inadequate infant health supervision are other factors present in "high-risk" groups which may be related to mild central nervous system insults which are not demonstrable by present methods of examination. There is some evidence to suggest that deprivation of social stimulation essential to normal intellectual development may be a contributing etiological factor in this group.

These persons without demonstrable nervous system pathology most often have mild degrees of retardation as measured by intelligence tests. That is, most of this group fall in the range of IQ 50 to 75. The schools usually consider them to be educable children; they generally exhibit moderate or mild impairments in adaptive behavior.

The label "cultural-familial" does not imply etiological factors but rather reflects: 1) the statistical association between mental retardation and certain subgroups in the general population; and 2) the high probability that more than one member of the cultural-familial family is also retarded. The designation further requires: 1) that there be no evidence of biological factors or organic conditions which could account for the intellectual deficit; and 2) that there be at least one parent or one sibling who is functioning subnormally. The latter criterion is often not carefully evaluated, most probably because it is too difficult to obtain this information. Thus, in the absence of a plausible organic explanation of the retardation, those persons who obtain IQ scores between 50 and 75 are usually designated "cultural-familial retarded".

Prior to World War II, surveys of the distribution of intelligence test scores among these economically deprived population groups were widely cited in support of theoretical views concerning the genetic determinants of intelligence. In particular, they were used to support the view that "cultural-familial" mental retardation was a direct function of hereditary determination.

In recent years there has been a less rigid adherence to this view as a result of increased sophistication in terms of our understanding of the nature of measurement of human abilities through standardized tests, and of the complex interactions involved in the expression of genetically-related behavioral characteristics. However, with the advent of social concern for the country's poor and those minority groups mostly found among the poor, there has been increasing acceptance and little critical challenge to the view that the high frequency of mental retardation found among the poor is directly attributable to deprivation of opportunities (available to the "non-poor") to learn and practice intellectual skills. Although statistics demonstrating a higher incidence of prematurity and other complications of pregnancy and delivery among economically disadvantaged population groups are sometimes cited as an explanation of increases in the prevalence of mental retardation among this group, it is clear that differences in prevalence of these conditions can by no means account for the substantially greater differential in prevalence of mental retardation. And so the social-deprivation hypothesis is predominant in spite of the fact that this view of etiology of "cultural-familial" mental retardation has little research evidence to support it beyond casual observations of the kind of learning opportunities of which children in poor families are presumed to be deprived and statistics which show that the average intelligence test score of slum-dwelling children declines as they grow older.

Despite the great increase in the national expenditure ofr funds for research in mental retardation, the "cultural-familial" mentally retarded children are rarely identified before they enter school at the age of six, and rarely are they referred to clinics, institutions, rehabilitation facilities and other agencies as are the retarded children of more affluent parents. They have, therefore, been relatively inaccessible to the researcher; and, no doubt, uncritical acceptance of the social deprivation hypothesis has further acted to deter research concerning etiology of this kind of mental retardation.

At the inception of the Regional Rehabilitation and Research and Training Center in Mental Retardation at the University of Wisconsin, it was decided to give major attention to research concerning etiology, prevention, and amelioration of rehabilitation problems presented by "cultural-familial" mental retardation. The first problem in the initiation of a program of research in this area was the matter of bringing "cultural-familial" mentally retarded individuals into accessibility for investigation. Simple awareness of the comparatively high frequency of mental retardation in certain rural and urban areas, i.e., where the economically disadvantaged are concentrated, was of little help because of the fact that most of the poor are by no means mentally retarded (a fact usually ignored by those who promulgate the social deprivation hypothesis of etiology).

As a consequence, our first step was to initiate a population survey in a residential area of the City of Milwaukee characterized by census data as having the lowest median family income, the greatest rate of dilapidated housing, and the greatest population density per living unit. Over a six-month period, all families residing in this area with a newborn infant, and at least one other child of the age of six, were selected for study. This selection procedure provided us with a broad range in age of children. The purpose of the survey was to provide clues as to methods of identifying those families among the economically-disadvantaged population group with a high probability of producing a retarded child.

The majority survey finding a relevance to the present study was that the variable of maternal intelligence proved to be the best single predictor of low intelligence in the offspring.

As seen in Table 1 , mothers with IQs less than 80, comprising less than half the total group of mothers, nevertheless accounted for almost four-fifths of children with IQs below 80.

Table 1

Distribution of Child IQ's As a Function of Maternal Intelligence

Mother's IQ	Percent of Mothers	Children's IQ % >90	% 80-90	% <80
>80	54.6	65.8	47.3	21.9
<80	45.4	34.1	52.7	78.2

Source: Heber, R.F., Dever, R.B. and Conry, J. The influence of environmental and genetic variables on intellectual development. In H.J. Prehm, L.A. Hamerlynck, and J.E. Crosson (Eds.), Behavioral Research In Mental Retardation (Eugene, Oregon: University of Oregon, 1968), p. 8

This relationship held even more strongly for older than for younger children as can be seen in Table 2 . That is, it can be noted that the mean measured intelligence of offspring of mothers with IQs above 80 is relatively constant as age increases. However, the children of mothers with IQs below 80 show a progressive decline in mean intelligence as age increases (figure 1). In other words, the generally acknowledged statement that slum-dwelling children score lower on intelligence tests as they become older held true only for the offspring of mothers whose IQs were below 80. Further, the survey data showed that the lower the maternal IQ, the greater probability of her children scoring low on intelligence tests. For example, the mother with an IQ below 67 had a roughly fourteen-fold increase in the probability of having a six year old child test below IQ 75 as compared with the mother whose IQ fell within the average range.

Table 2

Distribution of IQ's of Children Six Years and Older
As a Function of Maternal Intelligence

Mother's IQ	Percent of Mothers	Children's IQ % >90	% 80-90	% <80
> 80	54.6	68.0	51.6	19.2
<80	45.4	32.0	48.4	80.8

Source: Heber, R.F., Dever, R.B. and Conry, J. The influence of environmental and genetic variables on intellectual development. In H.J. Prehm, L.A. Hamerlynck, and J.E. Crosson (Eds.), Behavioral Research in Mental Retardation (Eugene, Oregon: University of Oregon, 1968), p. 8.

The selection procedure followed in this initial survey, that is, taking a mother with a newborn, and a child of the age of six, drew extraordinarily large size families into the net. Further, fathers were not evaluated. In a

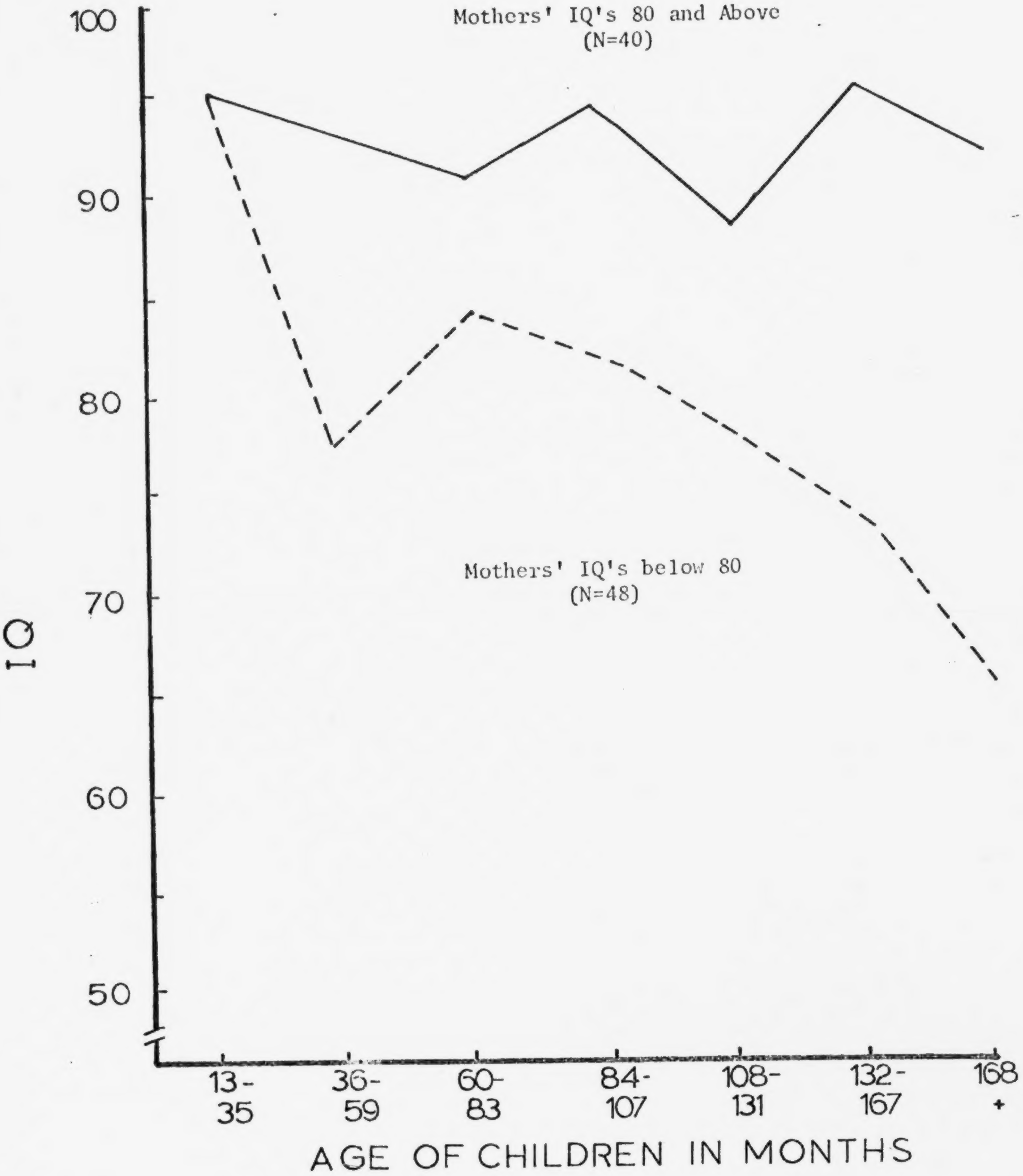

Figure 1. IQ Decrements in Disadvantaged Children Whose Mothers are Mentally Retarded

Source: Heber, R. F., Dever, R. B. and Conry, J. The influence of environmental and genetic variables on intellectual development. In H. J. Prehm, L. A. Hamerlynck and J. E. Crosson (Eds.), Behavioral Research in Mental Retardation (Eugene, Oregon: University of Oregon, 1968), p. 9.

second survey we took the families of over five hundred consecutive newborns in our study are. They were given an extensive interview schedule, and in addition, the mothers, fathers and all other children over the age of two were administered the Peabody Picture Vocabulary Test (PPVT) of intelligence. What was most surprising, as you see in Table 3 , was the striking congruence of maternal and paternal IQ. As you can see, 62% of mothers below 70 had husbands who scored below 70 and only 12% of those mothers had husbands who scored above 100. By contrast, mothers scoring above 100, in no case, had a husband who scored below 80.

Table 3

Percentage of Fathers in PQ Groupings as a Function of Maternal PQ Level

		Father PQ		
		<70	70-99	100+
Mother PQ	<70	.62	.26	.12
	70-99	.28	.50	.22
	100+	.00	.41*	.59

*No fathers in 70-79 range

As can be seen in Table 4 , the average age of mothers of newborns was comparable for all three IQ groups

Table 4

Mean Maternal Age and Percent of Absent Fathers as a Function of Maternal PQ

Maternal PQ	<70	70-99	100+
% Fathers Absent	34.5	38.6	35.0
Mean Maternal Age	25.4	25.8	25.1
N	119	280	120

but as is shown in Table 5, there is substantially greater depression of mothers under 20 and over 35 in the below 70 IQ group. This is reflected in the next table in the substantially greater number of offspring in families where both mother and father tested below 70. There is an average difference of 1.2 children between these families and those where the mother and father tested above 100; and considering that these families are, on the average, perhaps about half-way through their child-rearing years, the total difference in the number of offspring in completed families might be on the order of two and one-half. The adverse social consequences of this differential in reproductive activity here, or course, have been of concern to many and pertain irrespective of one's views of the etiology of the intellectual deficiency in these parents.

Table 5

Percent of Mothers of Newborns in Various Age Groups as a Function of Peabody Quotient

		Maternal PQ		
		70	70-99	100+
	20	.17	.16	.11
Maternal Age	20-34	.68	.77	.82
	35+	.15	.07	.07
	N	119	280	120

Our surveys have convinced us that the very high prevalence of this kind of mental retardation occurring in the slums of American cities is not randomly distributed, but is rather strikingly concentrated within a small proportion of families who can be identified on the basis of maternal intelligence. In other words, the source of the excess prevalence of mental retardation is the mentally retarded parent residing in the ghetto rather than the "ghetto" itself in any general sense.

At first glance, these population survey data seem to suggest direct support for the genetic hypothesis of etiology of cultural-familial mental retardation. However, simply casual observation suggested that the mentally retarded mother residing in the slum creates a social environment for her offspring which is distinctly different from that created by "ghetto-dwelling" mothers of normal intelligence. These observations and our survey data engendered our concern with an approach to rehabilitation of the family rather than, simply, the individual retarded adult. And the ability to select families "at risk" for mental retardation through maternal intelligence, provided an opportunity to longitudinally study a group of "high-risk" children before they became identified as mentally retarded. Thus, the results of the surveys of an economically disadvantaged population with an overall high rate of mental retardation suggested the direction and concern of the particular study discussed in this report.

The section which follows reviews past research which is relevant to issues in the etiology of "cultural-familial" retardation and which is particularly relevant to our investigation.

II

RESEARCH RELEVANT TO THE ETIOLOGY AND PREVENTION OF CULTURAL-FAMILIAL RETARDATION

Among some of our discriminated-against minority groups and the economically disadvantaged there is a disproportionately high incidence of cultural-familial retardation. A major problem has been created by the rush to embrace, uncritically, what has come to be called the social deprivation hypothesis. The eagerness to accept this notion and to attempt to fulfill its criteria as though it were a business contract is the result of our nationa's current interest in the plight of the disadvantaged, and the revitalization of our conscience regarding premises of our American heritage: equal opportunity for all. The problem is not with the enthusiasm or the intention of these efforts, but that its effect has been to distract research efforts from determining the epidemiological correlates of this retardation.

Even though available evidence implicates a number of variables in the general environment as influential in retarding cognitive development; it is scientifically irresponsible to say that it is the environment which causes the retardation; or even more specifically, it is not correct to say that it is poverty per se which causes mental retardation. Another argument is that the retardation results only when the middle class standards are imposed on non-middle class children in the schools. This latter argument is buoyed by the fallacious argument that many persons become mentally retarded only through the school years and yet make an adequate societal adjustment after schooling is done. Indeed, the data does show a sharp rise in the prevalance of mental retardation during the school years, with a subsequent decrease in the post-school years. However, recent research (Heber & Dever, 1968) indicates that mental retardation is more prevalent at preschool and adult age levels than is suggested by many of the prevalence surveys. A survey of a high-risk low-socioeconomic area of Milwaukee indicates that the areas which are characterized by a high prevalence of mental retardation among school children do, in fact, show a comparable prevalence among preschool children.

There are essentially three bodies of literature concerning intelligence which are bandied about in the nature-nurture controversy in an attempt to delineate the determinants of cultural-familial retardation.

1) Studies of Family, Racial and Socio-economic groups:

Since monozygotic twins have identical genetic backgrounds, it has been believed that differences in their intelligence when reared apart are attributable to their different environments. Burt (1966) has done much of the twin study research and reports a gradation of correlations between the IQ's of persons reared together or apart as a function of the degree of their genetic-relatedness. Indeed, the Erlenmeyer-Kimling and Jarvik (1963) review of the major studies correlating intelligence and degree of genetic relatedness of persons reared together and reared apart indicates that as the degree of genetic relatedness between persons increases, the correlation between their intelligence also increases. However, Heber, Dever and Conry (1968) show that when the date for the group reared together and apart is replotted separately, it appears that the differences between genetic groups per se are substantially larger than those for environmentally-differentiated groups. Thus, the data which have been used as one of the most powerful arguments for the genetic determination of cultural-familial retardation are not completely tenable. Furthermore, actual differences in the rearing environments in questions have not been assessed.

There are also certain known relationships between intelligence and other family variables which cannot easily be attributed to genetic factors. For example, measured intelligence decreases with increasing family size. Also among lower class groups, intelligence of the children decreases with increasing CA. Although, Heber, Dever and Conry (1968) point out: "Nevertheless, the correlations of family intelligence point to a distinct relationship between the degree of commonality in heredity and the degree of resemblance in measured intelligence which is difficult to interpret in support of an environmental viewpoint."

There is a significant relationship between intelligence and socio-economic status: children from lower SES groups score lower on intelligence tests than do children from higher SES groups. Unfortunately, interpretations of the socioeconomic class data have tended to ignore the fact that there is a continium of intelligence even within socio-economic groupings. For example, a relatively small percentage of families within the low socio-economic status group may contribute very heavily to the high prevalence of cultural-familial retardation identified with the group as a whole. In fact, a recent survey of a particular area of Milwaukee which has yielded the highest known prevalence of identified retardation in the city's schools, found that 45.4% of mothers who had IQ's below 80 accounted for 78.2% of the children with IQ's below 80. This relationship holds even more strongly for children above CA 6.

The above data are indeed striking, but even moreso are additional data presented by Heber, Dever and Conry (1968) from their Milwaukee survey data. This additional information is in the form of a plot of the IQ by age for two groups: The first is the survey children whose mothers have IQ's above 80; the second is the group whose mothers have IQ's below 80. What is most striking is that on the infant intelligence scales both groups score about equally as well; however, after the infancy period the children whose mothers have IQ's greater than 80 appear to maintain a fairly steady level while the children whose mothers have IQ's less than 80 exhibit a marked, progressive decline.

Thus, on the basis of these data, it appears that is not simply families within the low socio-economic groups that ~~contribute~~ most to the mentally retarded population; it would seem, rather, that it is certain, probably specifiable families which contribute most of these retardates.

2. Foster Homes and Adverse Environments: Observational Studies

A second body of data brought to bear on the nature-nurture issue derives from the study of intelligence of children reared in foster homes. These studies (e.g. Skodak and Skeels, 1949) have reported foster-child IQ's 20-30 points higher than those established or estimated for their true mothers. There is, however, a major problem in the interpretation of this data since the effects of foster home placement are generally confounded with certain selection factors, in that certain infants are assigned to particular homes: the more promising children are generally placed in the better homes. A further confounding factor is the option permitted foster parents to return a child who turns out to be mentally inferior. In effect, these two factors operate to increase the likelihood that highly intelligent foster parents will have highly intelligent foster children. The result is likely to be an inflated estimate of the role of environment.

Another set of studies (e.g. Spitz, 1945, 1946; Dennis, 1960) attribute their findings of significant retardation in the development of infants to the institutional settings barreness of intellectual and social stimulation. However, these studies suffer certain limitations because they have confounded institutional settings with the selection factors which may have predisposed these infants to be admitted to institutions in the first place.

3. Studies which Manipulate the Environment:

There are several manipulative-intervention studies which have attempted to provide special remedial education to mentally retarded, and/or culturally deprived children. Although in many instances controls are lacking or carelessly designated, intervention by education is the most sophisticated area of the three discussed, mainly because treatment is planned in advance. It is generally the case that prospective studies generally provide a much broader basis for inference and generalization than do retrospective studies.

One of the first entries into the new era of enrichment preschool studies was the Kirk (1958) study. Two groups of 3-6 year old children were selected with IQ's between 40 and 80: one group resided in the community, the other group was institutionalized. Within each group, half were designated an experimental group which received special tutoring and half of each group were untreated. Initial gains in IQ during the first year of the program were quite dramatic for the experimental groups, but then the subjects' IQ stabilized. Upon entering school, however, the untreated community group showed IQ gains which very nearly equalled those of the experimentals. The experimental institution group made gains comparable to the community group, while the untreated institution showed a rather marked depression of IQ over the preschool period. Actually, conclusiveness as to the effectiveness of preschool programs in facilitating intellectual waits upon long range results. The IQ increases noted in preschool experimental groups tend to wash out on school entrance; i.e., control children from lower socio-economic classes show a spurt in their first year of schooling and largely close the gap between themselves and the experimental groups. On the basis of these data from the early preschool intervention research, it appears that preschool training appears to add only slight increments to intelligence. We shall have more to say about this later.

What we have then is two viewpoints--geneticists vs. environmentalists--using essentially the same data. The genetic viewpoint however, suffers from what is known as the polygenic theory of intelligence--i.e., those certain aspects of intelligence are determined by the chance combination of genes contributed by the mother and father. Furthermore, these chance combinations or interactions are not necessarily transmitted to future generations--rather only single genes are transmitted, and these will combine in certain other random ways in succeeding conceptions. Therefore, the heredity of intelligence must be considered as having two facets: one directly transmittable, the other determined by chance combinations. If we are concerned with predicting intelligence we must be concerned with both facets. The environmentalist viewpoint on the other hand, has argued that intelligence can be modified by extreme conditions in the environment. However, even within the population of the cultural-familial retardate, seldom are there such extremes in environment. There is little to justify equ ating the environment of the typical orphanage and institutional environment to the characteristic environment of the culturally deprived child.

There is therefore, according to the above information, a definite need to rethink the nature-nurture issue. In all candidness, this report would have suffered little by its omission, (except for the fact that it provides some referents from which to discuss a comprehensive preventive approach to cultural-familial retardation). The studies used by both sides of the issue are fraught with methodological weakness making room for more argument but little in the way of effective, meaningful application. Opening this report with a brief consideration of what has thus far constituted the main body of data about which the nature-nurture issue has revolved was necessary, because it serves to point out the arbitrariness of the interpretation and the tenuousness of the conclusions. Furthermore, it effectively clears the way to report some vital developmental data and rather recent sophisticated attempts at preschool intervention.

Our aim in this report is to evaluate the existing body of scientific information associated with the growing problem of cultural-familial retardation in order to recommend a comprehensive program for the prevention and amelioration of cultural-familial retardation. We cannot discuss or discount the contribution of either genetics or environment to cognitive development. However, there are obvious profound consequences of environmental influences on development which can be dealt with, as compared to what we shall term the unobtrusive genetic contribution to cognitive development.

There is one other point within the context of this discussion and that is the question of socio-economic consequences of discrimination. Certainly they have existed and still do exist today, but with the possible exception of mitigating legal injustices, it is a problem for which there is no obvious "handle." If there is a conscience to this report, then it is one that will admit to attempting to right the socio-economic discriminatory ills from within: in other words, through education. It is not, then, that this report is ignorant of existing conditions, merely that its purpose is --again -- to evaluate the existing scientific literature with respect to its implications for normal intellectual growth.

Virtually all studies of stimulus deprivation have attempted an amelioration of intellectual defect by some sort of enrichment or compensatory education procedure in an attempt to replace or resupply children deprived of such stimulation because of their disadvantagement. This approach attempts to rehabilitate the developmental process for such children by intervening early enough in their development in an attempt to ward off or treat the detrimental effects on intellectual development caused by the depressing environment in which they grow up. There are both strong and weak aspects to this notion of compensation which has come to be known as the social deprivation hypothesis. It's strong points are that it has provided intellectual and nutritional benefits to otherwise disadvantaged children; and probably its strongest point: it has helped to orient children emotionally and attitudinally to the school setting and certain formalities associated with such. A major problem with the education of the disadvantaged in elementary school has been one of motivation, discipline and the maintenance of classroom decorum. The weak point of the social deprivation hypothesis is the hope that implementing an intervention procedure would prove a panacea. Unfortunately, the human organism is an extremely complex organism and can not be expected to respond normally when it is filled or unfilled with stimulation at random times. There is rather, a biologically related sequence of critical periods in early life at which time both optimum nutrition and stimulation must be available if development is to be optimal.

Therefore, not withstanding the contribution of heredity to an individual's intellectual development, what is available that we can do the most about are the extra-organismic resources necessary for normal development.* In other words, recognizing that for each individual there is a significant contribution made to his intellectual development by the genetics, we also must recognize that potentially significant contribution to his intellectual growth by the environment provided by society and by his parents. Further, on both sides of the argument there stands a common agent: the mother. She contributes to the child both genetically and psychologically, for it is the mother who creates the essential physical and psychological milieu in which the child develops. Thus, it will be the contention of this report notwithstanding the exceptions, that the most meaningful and by far the most practical means of dealing with the problems of cultural-familial retardation is through the manipulation of the environmental influences on development.

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*Certainly, we could include as extra-organismic resources--i.e., environmental influences--the nutritional adequacy provided by the pregnant mother paranatally.

Development: Early Experience

The developmental course of intellect is in the majority of cases a natural course of events. Once a child is exposed to the world the senses are expected to respond to the environment, each fulfilling its role, gathering information and feeding it into the central nervous system. A healthy nervous system can, acting as its own gate keeper, allow the important information to enter while blocking unimportant or noxious stimulation. In neurophysiology, this is referred to as gating at the periphery. However, the nature of the exteroceptive stimulation impinging on the child may be such that it interferes with the natural course of the development of the intellect, and it effects a retardation in intellectual and emotional development.

On the basis of the manifested intellectual and emotional behavior, the educational and psychological researcher has empirically established the relationship of intellectual and emotional deviancy to certain socio-cultural, social-economic, and biocultural patterns in society. Specifically, an increasingly large number of mentally retarded children, known as the culturally-familial retarded, are found to be correlated with low socio-economic status cultural and economic patterns of behavior. Further, it is suggested that the environmentally based roots of this behavior can be manipulated so that its damaging effects on development can be mitigated.

This part of the report will focus on development, specifically the child under 3 years of age. It is by far the most critical period of the child's life, with the exception of his prenatal experiences. The report will also examine why this period is so critical, what is normal behavior in this period, what is not normal behavior, what might cause this deviant behavior, and the prospects for mitigation and amelioration. Above all, the report will attempt to point out those aspects of development which could be controlled if the normal developmental course is to be realized.

In the early weeks of life the struggle to adjust is almost entirely reflexive. Considerable amounts of time are spent sleeping, waking only for nourishment. Even as the number of sleeping hours decreases, cortical activity is limited to reflexive reactions to direct sensory stimulation. As the infant matures, verbal communication becomes effective and he reacts to the words of people around him. Eventually he learns to call objects by their proper names and can give a verbal response to a direct stimulus. The mother, using gestures and words, singles out certain objects which makes them powerful and essential stimuli and attaches to the object a new significance. The child comes to reproduce the mother's gesture and to repeat the same word, thereby organizing its own perception. Such perceptual processes are formed in the child in a social way: voluntary attention, logical thinking, intelligent perception are complex processes formed in the course of a child's development as a result of verbal intercourse with adults and its manipulations with real objects. The functioning of such processes, which was previously divided between two persons gradually turns into an internal psychological method of organization of the child's own activity.

The preceding description is overwhelmingly simple, for each facet of this description lies on a dimensional gradient over which the quality and quantity of its effects can vary. We can ask such questions as what if there is not enough opportunity to sleep, or if there is no regular sleep routine, or what if the child is induced to sleep by minimizing stimulation? What if there is nothing but meaningless, loud, non-directed noise toward which the infant can not attend or establish any significance or what if there is almost no verbal communication directed toward the child, or what if the nature of the communication with the child is such that it seriously restricts the child in his intellectual and emotional development? What if there is no one to respond to a child, to expand on his verbalizations, to reinforce his communications and to induce an enthusiasm to explore and be interested in his world? What if the primary agents in a child's world either do not communicate with the child or are so inadequate and so inappropriate in their attempts that the nature of the entire course of a child's early development and therefore subsequent adult life are twisted beyond repair? "What if" is used here not only to structure a series of hypothetical questions which can be answered, but further its intent is to categorize certain all-to-often-taken-for-granted aspects of a child's early development period and consider the range of possibilities if things are not 'just so'.

Critical Period:

The importance of early experience can be delineated most poignantly by noting the existence of critical periods in development. We can consider for our purposes that there are three major kinds of critical-period phenomena: optimal periods 1) for infantile stimulation, 2) for the formation of basic social relationships, and 3) for learning. It is most important to note that the three kinds of phenomena represent not only a major developmental process in their own right, but are integrated in such a complicated fashion that damage to one seriously influences the other. The basic timing mechanisms for developmental periods are obviously the biological processes of growth and differentiation (or maturation). For various reasons, these are not precisely correlated with age from birth but it may be stated that the critical periods for an organism for certain kinds of stimulation, or forming of certain social relationship or for any specific sort of learning is the time when maximum capacities-sensory, motor, and motivational, as well as psychological ones--are first present. Why are there critical periods? Because both growth and behavioral differentiation are based on organizing processes. Once a system becomes organized whether it is the cells of the embryo that are multiplying and differentiating or the behavior patterns of a young child that are becoming organized through appropriate stimulation and learning, it becomes progressively more difficult to reorganize the system. In effect, organization inhibits reorganization. Further, organization can be strongly modified only when active processes of organization are going on , and this accounts for critical periods of development.

Significance of the Concept of Critical Periods:

The concept of critical periods is most important for human welfare. Once the dangers and potential benefits for each period of life are known, it should then be possible to avoid the former and take advantage of the latter.

The delineation and specification of critical periods focuses attention on the developmental processes which cause them and enables the modification of them to ensure the desired results. For example, if infantile stimulation of various kinds and degrees is desirable, parents can be taught to provide such in appropriate amounts at the proper time.

Thus far we have merely entertained the notion of critical periods without examining the empirical evidence that has been gathered to indicate the role of critical periods during early experience in determining later behavior. There is an obvious problem in delineating the effects of early experience on the human infant by experimental means: because the potential effects of early experiences on human infants are so profound in a grave sense and far-reaching that most experiments must be ruled out. However, there remain two other possible experimental approaches: 1) to study the results of unplanned accidents or 2) the minor variations in child rearing practices which are socially permissible.

As a result of this limitation many investigators interested in the effects of early experience began to study animal infancy. What has been found is overwhelming evidence that the early experiences of an infant-animalinfant-can exert major effects on related adult characteristics. The behavioral development extends back not only to infancy but into the prenatal life where the emotional state of the mother affects her offspring--and ultimately to the genes themselves.

However, as was noted before, a child is a holistic organism and various aspects of his early experience although discussed as such are not independent, but rather complexly interdependent. Therefore, the concept of critical periods has major implications for development, and when systematically examined has shown that there are various factors in each period of development which immediately or eventually modify behavior. Development in this sense then can be best analyzed in terms of the relationship between developmental processes and behavioral organization.

Behavior Systems:

The respective capacities of the afferent, efferent and central portions of the nervous system are the sensory, motor and learning capacities. Developmental changes in organs belonging to these divisions are inferred from appropriate changes in behavior. The importance of this notion is that the study of the development of behavior apart from any inference regarding the function of the nervous system reveals a fourth set of basic capacities: the increasing organization of behavior for adaptation to changes in the external world. Necessarily, this capacity requires behavior patterns involving activity of the whole organism. A behavior pattern is a specifiable group of behavior having a special function: e.g. the behaviors of nursing on the breast and the activity of hands, eyes and head that goes with it is a behavior pattern directed toward obtaining milk. As an individual grows older, the behavior patterns related to eating solid foods and drinking liquids are added. Such a group of behavior patterns having common general functions are called a behavioral system. Sucking, for example, is part of the ingestive behavioral system, which has the function of intake of nutritive materials, whether liquid or solid.

The first behavior functions to appear are those that are essential for survival. The very first is care-soliciting in the form of the first cry. The capacity for ingestive behavior is also present at birth. Investigative and exploratory behaviors appear as soon as the necessary sensory and motor capacities are present.

It is most important to note here that the concept of critical periods includes the times of appearance of sensory, motor and learning capacities and the time of origin of organized behavior patterns and uses them as developmental landmarks for evaluative purposes. As will be detailed later, behavioral development can be divided into periods based upon the occurrence of major developmental processes. Development is a dynamic process, or group of processes which wax and wane with time. These processes can be most easily modified when they are at points of maximum activity, as a process only exists when it is active.

Neonatal Period:

We can examine human development and detail evidence of the existence of natural periods, even during the neonatal period. The major process of the neonatal period is the infantile form of ingestive behavior and the resulting nutrition and growth. A baby's sensory capacities are well developed at birth, in that some response can be elicited by stimulation through all major sense organs. Newborn infants give a startle response to sound and respond in various ways to tactile stimuli. Infants will adapt or accomodate to strong odors (e.g. Lipsitt, 1966) just as adults will, after first giving a strong startle response. A second new odor will cause the startle reaction to reappear in full strength, indicating that the neonate can differentiate between odors. Other research has shown that the neonate can differentiate sounds by differentially responding to different auditory signals.

Visual capacities have been extensively studied in the neonate in the last few years. Neonates react to sudden changes in light intensity with pupillary and eye-closing reflexes and head movements. They will respond to changes in position of an object by following it with their eyes. Fantz (e.g. 1965) has extensively studied eye fixation in neonates, i.e. the time spent looking at any new object, is quite short at birth and greatly increases between 6 and 10 weeks, after birth.

Electroencephalographic recording in the visual area of the cortex indicates that the alpha waves associated with visual attention in the adult, do not appear until the infant is nearly 3 months of age. Taken together with behavioral evidence it indicates that vision is poorly developed in the neonate, remains at this level for the first month and a half, and then begins to improve rapidly over the next two to three months.

Motor development proceeds at a considerably slower pace than that of sensory capacities. The human infant is incapable of any form of locomotion and can only move his arms and legs in a weak and uncoordinated fashion. Most infants cannot turn over, and merely turning the head is one of their major motor capacities.

Learning capacity is limited in the neonate. There is some evidence that sucking can be conditioned by the use of reinforcement techniques (Lipsitt, 1967). Also, some of the data on adaptation to odors (e.g. Lipsitt, 1966) has been considered as a habituation phenomenon basic to learning. However, most evidence suggests that human infants begin to be capable of rapid stable conditioning at around five weeks of age. Papousek (1967) was able to condition babies to turn their heads in response to a buzzer sound by rewarding them with an opportunity to suck from a bottle. Newborns took nearly four and one-half times as long as three month old babies. However, the explanation of the results is not conclusive, but contributes to the general evidence that shows learning capacities improve tremendously during the first three months after birth. But, it is important to realize that the learning capacity of the central nervous system at this stage of life is limited because of limited sensory and motor abilities.

Patterns of social behavior are likewise limited in the infant. Care-soliciting behavior in the form of crying, appears at birth and is the standard response to any form of phsical discomfort, including cold, hunger and pain.

The neonatal period, it may be concluded, may be chiefly characterized by nutrition. No other major developmental processes are evident, although certain kinds of transitions begin to appear at 5 weeks and later at about 2 1/2 months. The neonatal period includes the first 6 weeks after birth.

Period of Socialization:

The first major change in a baby's overt behavior is the appearance of the social smile at approximately 5-6 weeks of age. Spitz and Wolf (1946) first demonstrated that smiling could be regularly elicited at this time by the sight of a human face or even a mask resembling a face. Before this age, an infant may give fleeting smiles but not in response to visual stimulation.

The social smile is a very important form of human social behavior, persisting throughout life and having the general function of signalling a friendly attitude. Spitz and Wolf found that the rate of smiling at strange faces by orphanage babies increased up to five months of age, but by 6 months the rate had dropped almost to zero, although the babies continued to smile at familiar faces. After 6 months of age, an increasing number of babies show fear responses and cry in the presens: of strangers.

Ambrose (1961) replicated the Spitz and Wolf studies and essentially confirmed their earlier findings. More interestingly is his finding that home-reared infants begin to smile at their mothers about a week earlier than the age at which orphanage babies smile for the first time at a human face. Home-reared infants also begin to discriminate against strangers earlier than do babies raised in orphanages (Gewirtz, 1965).

Thus, from about six weeks through approximately six months of age it is easy to make positive social contacts with infants. Indeed, the infant itself is able to make contact with strangers at a distance through the smiling response. All the evidence indicates that this is the period of primary socialization, during which babies become attached to certain individuals and that by its end they begin to discriminate against strangers.

A landmark for the end of this period is suggested by Schaffer's (1958) studies of children who were hospitalized and later returned home. All infants showed some emotional disturbance: those younger than 7 months continually scanned their physical environs while the infants older than 7 months showed overdependency, consisting of excessive crying when left alone, continued clinging to the mother, an increased fear of strangers, and even fear of familiar individuals within the family. Therefore, with considerable variation, the end of the period of socialization is about 7 months of age.

Periods of Transition:

The transition to adult sensory capacities has relatively little importance in human infants compared with that in other animals. There is some change in the visual capacities around 2 1/2 months and in the ingestive behavior system, the latter changes coinciding with development of teeth (approximately 7th to 15th months). The transition to the adult form of locomotion covers about the same time period. The median age of crawling is 7 1/2 months; creeping 11 months; and walking, 15 months. All of these changes are extremely important for the process of socialization. For example when the fear of strangers develops in the infant, it is because he comes to discriminate among faces, but he also becomes capable of moving away. Thus, major transition processes occur between 7 1/2 and 15 months of age and chiefly involve motor capacities.

However, coincident with the end time period, a highly significant type of transition occurs: the transition from infant communication--e.g. crying, babbling--to the adult form of communication--using words. The median time that the first word is spoken is about 15 months of age. Around 27 months age, a child begins to use more than two words at a time, is starting to speak in short sentences. This period can be referred to as a second transition period to the adult form of communication, and includes the time from 15 to 27 months. Following this transition, there begins a long period of verbal socialization, in which social relationships begin to be developed and modified through verbal communication.

Complexity of development of learning capacities:

Learning capacities in the neonatal period are quite limited and consequently the results of early learning in this period are likely to have only limited effects upon later behavior. However, the risk of physical damage is greater than in later life because physiological developmental processes are still proceeding rapidly. Therefore, during the neonatal period, the risks of physiological damage to the nervous system are much greater than those for psychological damage.

This situation changes rapidly and by 8 to 10 weeks of age, the infant can learn certain things quite rapidly, especially in the form of making simple associations and forming habits. Information received through verbal communication is not possible in any great quantity before approximately two years of age and is limited even at that time. Consequently, there is a period of two years in which the infant can learn things on a non-verbal basis before he begins to learn through words. However, specifically what is learned in infancy is not ordinarily accessible through verbal recall. Rather the observer of child behavior must rely as much on experimental tasks as an intuitive judgment to evaluate the young child during this stage of development. There is every reason to believe that while verbal learning is ordinarily dominant in the control of human behavior, non-verbal period influences and may even conflict with what is learned on a verbal basis. In other words, the emotional development of the child through the first two years has a powerful effect in how and what ever else is learned.

General Theory of Critical Periods:

At this point, it would be informative to digress for a more detailed examination of the implications of the concept of a critical period: A critical period can be defined as a time when a large effect can be produced by a smaller change in conditions than in any later or earlier period in life. From this viewpoint, critical periods have enormous practical importance for the modification of behavior through training and education. For example, in the critical period for primary socialization, a small amount of change in the contact at an early period of life will determine the emotional state of the infant for many months and possibly for the rest of its life (Bowlby, 1961). Similar changes in contact in adult life produce only minor reactions, often momentary, to e.g. passing strangers or short term friendships.

Therefore in the developmental process of primary socialization, we can reason that if at a critical period in life a major new relationship is being formed viz. organizing its first social relationship - then it is a critical one for determining the nature of that relationship for the remainder of one's life. Such a period exists around seven months, as can be seen from the consequences of separation for the child at this time. In fact, the period of primary socialization is an unusually critical one in that evidence suggests that it may directly or indirectly effect the formation of all subsequent relationships of the individual throughout life.

The period from approximately 5 or 6 weeks of age - marked by the appearance of the smiling response to human faces - to 6 or 7 months of age - marked by the infant's differentiation of human faces and the decrease in the rate of smiling to strangers - is the period during which the process of primary socialization takes place.

In other words, it is the period during which the child forms his first social relationships and it is usually with the parents. Since it usually has more contact with its mother than any other individual, the earliest and presumably strongest relationship will be formed with her, although under other conditions of child rearing it would be possible for a baby to form a strong relationship with any individual who took care of it.

Let us consider the concept of stimulation as lying along a dimension marked high and low. Further consider that coincident with this dimension of stimulation, there is a dimension along which optimal stimulation for normal growth can be plotted. What would appear then is a curve somewhat like the normal distribution curve with a peak around the middle of the high-low dimension of stimulation. Probably this is not the true curve for every different form of stimulation but it does represent the general picture for optimum stimulation. High amounts of stimulation could be e.g. much too much noise for long periods of time, or continually changing guardians during early development. Low stimulation - in an extreme sense could be e.g. no sounds and no one in the environment - as in total isolation. At this stage of life, although there is no specific characterization of the optimal environment available, we do know what are the extremes and what are the resulting deleterious effects on growth. In effect, we can say with considerable definitiveness what should be avoided but we can only discuss in general terms the optimal stimulation conditions for development.

The Effects of Isolation:

Drastic experiments with social isolation of human infants are never performed for obvious reasons, and what evidence we have is confined to accidental cases in which children have been hidden from the outside world for criminal or emotional reasons. Further, even though we know little or nothing about the conditions of the isolation, making prediction extremely difficult, we do know that generally there are profound abnormal changes in development of social behavior for the isolates. Young mammals reared in isolation manifest bizarre and striking changes in behavior.The longer the isolation is continued, the more drastic are the results.

Although drastic isolation experiments are never done on children, isolation occurs commonly enough in normal experience for us to know something of its effects. Short periods of isolation often produce crying and a strongly unpleasant emotional reaction.

Children's lives differ a great deal with respect to the number and closeness of social contacts that are permitted during early development. Some children grow up in remote rural areas with a limited group of family acquaintances. These children might be expected to develop more shyness to strangers than children exposed to many different people. An example of the latter situation are children who are sent to nursery school where there is much opportunity to interact with other children, and other adults than parents. However, there are examples of children which grow up in what appears to be essentially normal homes and yet develop autistic behavior. In this case, the child is withdrawn into himself and is unresponsive to others. The behavior is remarkably similar to young animals raised in isolation, except the circumstances here are different. There appears to be a serious derangement of the whole process of socialization and the development of emotional reactions.

Unlike rearing in isolation, but another variation in the possible influences on the development of the process of primary socialization is the breaking of social relationships - short or long term. The probability for these kinds of situations is quite high what with the possibilities of sickness and hospitalization, death of a parent(s), divorce and other descriptions of family life. There are many problems which result in attempting to replace or restore the broken relationships.

Bowlby (1951) found that children separated from their parents and familiar surroundings; e.g., by hospitalization, are seriously upset by these experiences. As a result, hospitals have encouraged frequent visits by parents and decreased as much as possible hospitalization time. Schaffer (1958) found two kinds of reactions in babies returned to their homes after a period of separation in hospitals. Before 7 months, babies show what he calls a "global syndrome", becoming depressed and staring anxiously at everything in the room, living and non-living. After 7 months, the babies show an overdependency syndrome. They cry a great deal and try to avoid being separated from anyone who is caring for them. The earlier reaction is related to change in the physical environment and indicates that the babies have become attached to their surroundings and are disturbed by leaving them. The changed reaction after 7 months indicates that the baby is now reacting primarily to the separation from people, which is equivalent to the temporary breaking of a social relationship. Permanent separation produces even more drastic effects. Children transferred to foster mothers at sometime after 7 months were found (Yarrow, 1964) to show reaction severe enough to be called emotional trauma. Much of the emotionality associated with separation is usually dissipated as the child grows older. He should become more capable of managing separation for long periods, particularly after he has learned to talk and begins to have some concept of the time at which his parents may return.

Most parents are familiar with the emotional symptoms of separation when children are left for a few days with a baby-sitter. The children are upset and hard to handle, given to frequent periods of crying.

An experienced baby-sitter soon learns to keep the children amused and stimulated in order to counteract the child's emotion of depression. Actually, the child has been emotionally hurt by the parent and may react with coldness and antagonism, and may even be reluctant to enter into warm social relationships--especially if the separation has been long. Quite obviously then, breaking a social relationship, even for short times, is a very serious matter for a child, and must be dealt with carefully by the parent. However, what about the child whose parents never establish a close, warm relationship with their child, let alone violate an established relationship? Can an older sibling or teen-age baby-sitter provide this kind of relationship?

Thus, even with a limited sampling of situations, we can see that variation in the early social environment can produce drastic changes in behavioral development, particularly through the modification of the process of primary socialization. Disturbances of the process produce emotional reactions, the nature of which during this critical period for primary socialization may determine much of the organization of social behavior in later life. The long range effects may involve a simple transfer of social behavior patterns to inappropriate objects or individuals, or they may involve drastic changes in these patterns - even to the extent of complete suppression. Most especially, the effects involve the organization of social behavior between individuals, with a resulting modification of social relationships.

Nutrition and its implications for Development:

A number of recent articles (e.g., Densen and Hayes, 1967) have reported the higher incidence of many types of illness in non-white segments of the population at all age levels. Further, many of these illnesses can be traced to nutrition. Considerable evidence gathered from the study of population at nutritional risk (e.g., Cravioto, Delicardie and Birch, 1966) indicates a systematic relation between nutritional inadequacy and both neurologic maturation and competence in learning. Incidents of severe malnutrition appear rarely in the United States today, but evidence suggests that the low income segments of the population suffer from subtle, sub-clinical forms of malnutrition which contribute to the higher rates of morbidity and mortality of children in this group (Birch, 1967). Brock (1961) defines inadequate nutrition as any impairment of efficient functioning of body systems which could be corrected by better feeding.

The question remains as to how, in a society with an abundant food supply, certain population groups are not adequately nourished. There appear to be two possible answers: money and information. Cultural differences in food habits and beliefs, though important, lose their significance when more funds, better education and sound knowledge of proper nutrition became available. However, even though a detailed and comprehensive study of the nutrition of the low income population is still lacking, a serious consideration of available health information leaves no doubt, according to Birch (1967) "that children who are economically and socially disadvantaged and in an ethnic group exposed to discrimination, are open to massively excessive risks for maldevelopment."

The inadequate nutrition suffered by these children predisposes them to ill health which can directly affect the development of the nervous system and result in clinically definable abnormal intellectual functioning. Further, children who are poorly nourished are reduced in their responsiveness to the environment, continually bothered to distraction by their hunger and reduced in their capacity to persist, endure, and progress in learning situations. In effect, the implication is, that state of organism may modify the effective environment and dissipates whatever intellectual experiential opportunities may be provided or to which he is exposed. It is particularly important for our present discussion to point out that it is foolish to assume that one can provide equal opportunity for learning through identical preschool programs for advantaged and disadvantaged children. Although such programs are necessary and should be established, the concern for the disadvantaged child should be extended to include the health and functions and physical well being of the child. Illness derived from poor nutrition 1) may result in loss of learning time; 2) can interfere with learning during critical periods of development; and 3) cause motivation and personality changes.

The first point is rather obvious and the second we have already discussed the implications. The third point is particularly important and touches upon a subsequent discussion of the sensitiveness and criticalness of the mother-child interaction.

A mother's responsiveness to a child is to a considerable extent a function of the child's own characteristics of reactivity. A related example is a recent finding by Frey (1966) that many deaf infants could have received earlier help since they were not completely deaf, but their mothers lost interest in continually calling after a child who rarely responded. Malnourished children behaviorally are reduced in responsiveness and show various degrees of apathy! This apathetic behavior effectively decreases the adult's responsiveness to him. In effect, apathy leads apathy with a cumulative pattern of reduced parent-child interaction. The result is a retardation in cognitive development since there is little or no stimulation for learning, maturation or interpersonal relations. We will continue this discussion in the section titled "the nature of mother-child interaction."

Manipulation of the Environment

Restricted Sensory Stimulation:

The effects of restricted sensory stimulation upon the development of sensory capacities are, as pointed out earlier, derived primarily from animal research, since it is not possible to test these effects upon human infants. However, consider that physical forces are always impinging upon any living organisms and the chemical composition of the physical environment continually changes. These forces and changes in turn act upon the sense organs to produce internal physio-chemical changes that act as behavioral stimuli. We ordinarily take such stimulation for granted, and it is usually only when it is drastically altered by experiment or accident that we can detect its effects on behavioral development.

Even before the development of the sense organs, environmental changes can alter the physiological reactions; e.g., the effect of heat upon the rate of chemical reactions. Furthermore, evidence is now being accumulated that certain kinds of environmental stimulation are necessary in early life for normal behavioral development. What experimental work has been done is mainly with visual and tactual stimulation. It is know, however, that congenitally deaf persons have great difficulty in learning to talk and if not given early attention, may remain mute.

Visual Stimulation:

Again, because it is impossible to perform isolation and deprivation experiments with human infants, most work has been done with animals. The chimpanzee, however, has sensory capacities very similar to those of human beings, and shows similar behavioral development. A most significant isolation study was performed by Riesen (1961) at the Yerkes Laboratory. He reared several infant chimpanzees in various conditions of light and darkness. Those animals raised in complete darkness showed degeneration of the ganglion cells of the retina, as well as biochemical changes in these tissues. Riesen concluded that the retina, like many other nervous tissues, did not develop properly in the absence of stimulation. Function is necessary for development in postnatal life as well as in embryology. While even though most organs develop to a considerable degree before they become functional, their final form is affected by use. Additional experiments by Riesen (1961) showed that the experience of deprivation of visual stimulation produces direct effects on behavioral development in addition to those produced indirectly by physiological alteration of the sense organs.

It is possible to study the development of the visual capacities in infants by using the visual fixation response. Infants which have their eyes open will look at objects selectively and for different periods of time. By photographing the mirrored image of a fixated object off the cornea of the eye, it is possible to obtain a measure both the choice of objects fixated and the time spent fixating the object. Fanty (e.g. 1965) has found that the time of visual fixation is very brief until the end of the neonatal period (approximately six weeks of age), at which time there is a rapid increase in time of attention to various objects. This is also the time when infants begin to give the social smiling response, which is evidence again for the development of the capacity of visual discrimination.

Tactile Stimulation:

Babies are highly responsive to touch, and there is much evidence that neglected babies or those given a minimum amount of physical care (e.g. in an understaffed institutional setting) develop less rapidly than others and sometimes actually regress in development. Extensive investigation of "handling" stimulation of newborn puppies and rats has confirmed the principle that stimulation is necessary for the development of basic behavioral capacities. Rats given extra handling (Denenberg, 1967) from birth grow up to be hardier adults: they grow faster, live longer, and stand physical stress such as lack of food better than animals which have been left undisturbed.

This extra handling might be compared to the sort of experience which human infants might get in an orphanage if a nurse gives them extra care and attention. In fact, these results obtained almost entirely with rats do apply to human beings. Infants reared in orphanages or kept in hospitals and given a minimum of handling (i.e., understimulated) may become behaviorally depressed and even physically ill, in contrast to active and healthy children reared in a normal family situation. Long, continued restriction of movement will lead to great motor retardation (Dennis, 1960). All evidence indicates that tactile stimulation in early infancy is not only desirable but essential to normal development. Such stimulation should normally be regularly provided in the course of the constant care and attention which a mother gives her child. Her treatment is ordinarily gentle, but no harm is likely to result from brief changes in temperature and occasional bumps. On the other hand, the baby does not need to be constantly stimulated and in early infancy needs and normally spends most of its life resting and sleeping. Thus, the evidence suggests human development is designed toprogress normally under conditions in which considerable but not continued physical stimulation of many kinds takes place during waking hours, and that drastic reduction of this stimulation may impair development.

STIMULATION, PRACTICE AND ENRICHMENT:

Effects on the development of learning capacities

Animal experiments (viz. rats) with enriched environments indicate that there are critical periods during which the development of learning capacities can be easily enhanced. These periods seem to occur shortly after the time of weaning, when the infant animal has developed some independence and still has not developed strong fear reactions to strange objects. On the basis of this finding with animals, it would seem that a comparable period in human development should occur after the child develops the capacity for walking and independent locomotion and also has acquired a full set of teeth so that he can live on solid food. This period occurs around the age of two, because it is the age by which a child has achieved a moderate degree of physical independence, and is manifested in a tendency to explore and be curious about the world at this stage of development. Obviously, there is another index or landmark of a critical period for learning which occurs around this age: the beginning of language facility. Beginning around the age of two, any normal child can learn a language, and even two languages at this time. As a child grows older, learning a second language becomes increasingly difficult. This phenomenon involves both complex auditory skills and motor coordination.

Enriching the Early Environment

Large scale "enrichment" programs have been implemented in the last ten years. The size of these programs as well as their aims are somewhat in contradistinction to the miniature demonstrations done several years earlier. McGraw (1939) differentially trained identical twin boys by giving one of the pair extensive practice in various motor skills. The fact that the twins were later found not to be identical does not disturb the reasonableness of the conclusions drawn from her results: she concluded that there are critical periods when any given activity is most susceptible to modification through repetition of performance. The critical period in each case is the time following the age when the child is first capable of performing the act effectively. The practiced twin was given practice in tricycling at eleven months, and improved very little until nineteen (19) months, when he improved rapidly, but not so rapidly as his twin who started at 22 months. Starting training either too early or too late is likely to produce inferior performance.

In effect, the interpretation of the findings of the McGraw study underscore an earlier conclusion; that the complete development of muscular coordination is dependent upon function, in much the same way that development of muscle cells and the maintenance of muscular tone are dependent upon exercise. In other words, function is an important factor influencing development. But her results did also indicate that practice and contacts with a variety of physical objects at critical periods will speed up and amplify the processes of development of motor skills.

On the other hand, however, reliable indices of problem solving abilities and intelligence have not been obtained until children are much older, often waiting upon some formal school training or its equivalent. By that time all results indicate that children having a restricted environment either at school or at home, do less well on intelligence tests than those reared in more favorable environments. Whether this result is related to very early infantile experience still remains open to empirical investigation -- preliminary data are only now beginning to be gathered concerning this question. However, much evidence has been gathered that in general, children from low socio-economic deprived homes do not do as well as children from advantaged homes. Such findings are acceptable because it is expected that a child's intellectual development should be strongly affected by its opportunities to explore and become familiar with a complex physical environment particularly in areas where the child can easily relate later learning tasks to his early experience. An important point related to this discussion is there is a real possibility that the opposite of an enriched environment and its enhancing effect on cognitive development may not simply be that the non-enriched or deprived environment merely does not enhance cognitive development. Rather, a deprived environment may have quite a powerful effect in one of two ways, each with the same result: 1) it actively depresses learning opportunities and therefore restricts cognitive development and/or 2) it causes the dissipation of learning potential due to degeneration of behavioral skills and even physiological systems necessary for intellectual development, resulting in mental retardation. An analogous example of this concept in action is the death of an unwatered flower. The flower withers and dies not only because it is not watered, but also because the water it had is both consumed and evaporated. The comparison to a young growing organism is obvious.

The effect of an enriched environment could be a self-enhancing one in a society such as ours. The more capable a child is, the more he is able to provide himself with an enriched environment which enhances his capability still more. Children raised in an enriched environment would thus become capable of providing comparable or better surroundings for their own offspring, while children raised in an impoverished environment would be less likely than others to develop sufficiently to improve it and would therefore tend to rear their own children in the same impoverished condition.

As was mentioned before, attempts to circumvent or mitigate the effects of impoverished, disadvantaged environments have been attempted in the form of early enrichment or compensatory education projects, such as "head start" programs. We will examine them in a later section in the light of our present discussion of critical periods and the additional arguments upon which these programs were originally based.

On the basis of our present discussion and in the light of our subsequent discussion, one can say that we know less about the timing of the optimum period for a child's exposure to an enriched environment than we do for a young animal. However, what evidence we have gathered should caution any optimism for successfully compensating for deprived development at nursery and kindergarten school ages. It may be that at this age the child is past the optimum period, and that the most effective time for laying the basis for the development of learning capacities is during the long period of pre-verbal learning that comes before 2 years of age.

There is a major problem of the basic nature of the development of social motivation. Almost all learning in the early school environment takes place within the social relationship developed between the mother and child and is transferred in a general way to the relationship between pupil and teacher. If the child's early environment has not prepared him to develop a reasonably close and pleasant relationship with his teacher, his motivation and consequently his learning capacities may suffer. A child can develop, e.g., negative learning sets, in which under certain circumstances he does not learn. Such a result can be produced in many different ways, but one of the most important is the experience of failure. A child that continually fails in a situation soon stops trying. Children may develop unpleasant emotional associations for certain situations and thus their motivation to achieve is dampened because they are frightened and/or continually fail each time they enter this situation.

In effect, a child's self-confidence and emotional comfort with his environment has a considerable influence on his development of the manner with which he deals with the world.

Preschool Intervention with Compensatory Education

The widespread concern with programs of early intervention is of recent origin, and many of the difficulties in adequate national assessments of such programs relate to their extremely rapid growth. For example, both Project Head Start and Follow Through were initiated with great haste, which makes any evaluation of quality difficult. Head Start programs were shaped to a considerable extent at the local level, and have been quite heterogeneous--some excellent and some quite poor. Assessments made of both types together obviously dilutes any indication of the effectiveness of the good programs and furthermore, masks the reasons for the ineffectiveness of the poor projects.

It would be profitable to look at a few relatively well defined and controlled studies of early intervention which are far enough along to give a picture of results over time, and to examine this information for contributions to the question of the educability of young children from low income homes.

There are several major considerations to keep in mind with respect to the evaluation and possible implementation of such programs. One, is the amount of work it takes to get a measurable effect from the children's performance in terms of improved functioning. Sustained modest gains have been found in some of the better studies. However, such findings have come from studies where the children there have spent considerable time in the program, with a great deal of adult-child contact and there has been considerable and detailed preplanning of the program. Secondly, aspects of a program vary with age of the child at the time of intervention.

Really young children, say 6-15 months, might take somewhat less time per teacher per day if they nap at least twice a day, but then again these children need more individual attention, but also the curriculum is not so complex. A third area of concern is establishing a program which enables close, immediate opportunity to evaluate performance of children as a function of the experimental treatment. More often than not, teachers vary considerably in ability and technique which might therefore reduce the general effectiveness of the program by tending to extreme differences between subjects in their development. Also this problem requires that concern be given to the type of teacher and how long they can stay with the program. A teacher committed to techniques other than those prescribed by the program implementer, or a teacher who remains with the project only for a summer, can not be considered as effective as a teacher committed to the unique techniques of the program and able to stay for longer periods of time than, e.g., a summer. Fourthly, the high mobility the low SES samples employed in these studies has considerably diluted the longitudinal measures of improved performance even with the most long-term program. Furthermore, comparison control groups often become involved in other programs or suffer from attrition which similarly affects the experimental children. This makes both "running" comparisons and final evaluations difficult and in some cases tenuous at best. Moreover, a major problem is the child's real world deprived milieu which created the deficit, for it continues during and after any intervention program to act upon the child. With such factors continually operating, it is not particularly surprising that there are relatively few successful and carefully documented studies.

Skeels' (1966) study represents a 21-year follow-up of the early studies by Skeels and Dye (1939) and by Skodak (1939). The experimental group consisted of 13 children in an orphanage. Their average was 19 months and had a mean IQ of 64 at the beginning of the intervention. These youngsters appeared so delayed in development that no adoptive placement had been made for them. These children were placed in an institution for the mentally retarded under the care of some of the older female inmates, mainly because the orphanage from which they came was overcrowded, with limited resources and staff. In the ward placement at the institution for the mentally retarded, a patient or attendant took over the role of mother surrogate for the child. She spent considerable time playing, talking and training the child. The living quarters in the institution were fairly open and there was an outdoor playground with appropriate materials. Skeels reports that the mother-surrogate took great pride in "their" children, and even developed some competition as to whose child could learn the most. The children attended nursery school and kindergarten, and were also exposed to other enrichment programs. In the first follow-up study, 11 of 13 experimental children had been placed in adoptive homes and had retained their earlier gains in intelligence.

The contrast group consisted of 12 children considered normal in mental development and placeable. The mean IQ was 87 and their age was 7 months at the start. After nearly two years, while the experimental group had gained 28 IQ points, the contrast group had lost an almost equal amount.

Twenty-one years later Skeels, in a follow-up of the two groups, found that they had continued to maintain their diverging patterns as they had moved into adulthood. The experimental group had completed grade 12 (median), were all self-supporting, while the control group had achieved only the third grade, showed markedly differentincomes, and five of the control group remained in institutions.

The results of the Skeels study are so striking that it is a landmark in the field. Two things are particularly important: one, the placement in the institution for the mentally retarded appeared to have carried with it two of the most desirable aspects of the early intervention programs--a high adult-to-child ratio in a warm, a presumably consistent environment, and a high stimulus potential in the environment as compared to their earlier situation. Above all, there was continuous intervention over time--it did not cease when the child was placed, but rather continued. At the same time another kind of intervention continued for the contrast group, one which had all the adverse effects of the early environment.

The Early Training Project of Klaus and Gray was initiated in 1961 with individuals from low income Negro homes in the upper South. The children were randomized into three groups. One group entered the intervention program three summers prior to public school entrance into the fourth grade, one experimental group two summers prior to such entrance; the third group had no intervention. A fourth group was included in the design, a similar group from a town 60 miles distant. The intervention consisted of an assembled program during 10 weeks of the summer, followed by nine months of weekly home visits from a specially trained worker. These visits had as their primary purpose an attempt to involve the mother actively in sustaining and increasing the gains the child had made during the summer months. The intervention program was constructed around variables relating to aptitudes conducive to achievement. There was a ratio of one adult for every four children. Through the seven years that this study has been underway, there has been little mobility in the group, with 56 of the original 61 children being maintained.

The general situation and experimental design has made possible some interesting comparisons. On tests of intelligence using the Binet, the experimental group has remained significantly superior to the control groups. Up until the age of school entrance, the experimental group showed a modest gain accelerated beyond what had been anticipated; the control group showed a slight decline. In first grade all groups improved, and then over time, in a parallel fashion across four groups, there has been a slight decline. This latter finding may be related to the massive impact of the environment and the school situation, which could be categorized at best as mediocre. Significant differences remained on the Illinois Test of Psycholinguistic Abilities through first grade, and through the second grade on the Peabody Picture Vocabulary Test. On the two tests of school achievement used, the Metropolitan and the Stanford, the experimental children were slightly, but consistently superior to the control children. The differences were significant for the first two years of schooling, but by the end of fourth grade, the differences were no longer significant.

Considering the effort involved, such effects at first glance are less than overwhelming; yet, the remarkable thing is that with all the impact of home, school, and community, the differences on intelligence are still holding up and that consistent trends remain on the other measures.

There are two other significant byproducts from this study which are particularly relevant to planning adequate intervention programs. One is the horizontal diffusion or spread of effect from children and parents in experimental groups to other children and parents living in close proximity to them. The Negro group in this study, as in other cities, live close together and there is a great deal of intermarrying among this group. Where an intervention program is seen as highly desirable by the community, an ideal setting is provided for spill-over effects. In this way, existence of local efforts are made known to many, and probably some of the within family treatments are shared with other families. Also there is vertical diffusion, the spread of effect from older to younger siblings. Children closer in age to the experimental children were found significantly superior to the younger siblings from the control groups. Apparently, in terms of intervention techniques taught the mother, there is more spread of effect to the children closest in age to those for whom the technique was designed.

A third early education program is the Perry Preschool Project headed by David Weikart in the Ypsilanti, Michigan, schools (Weikart, 1967). Since the Perry Preschool Project began in 1962, four groups, or "waves" have been through two years each of the intervention program. The program has changed somewhat over time, beginning originally as a program of "verbal bombardment", to an approach somewhat more Piagetian. Weikart's group were three- and four-year-old children from culturally deprived families. The mean initial Binet IQ of the "waves" over the four years varied from 78 to 80. The school based program consisted of a 2 1/2 hour morning class for the youngsters. There was in addition a home-based afternoon program. The teachers of the morning program visited in the home of each youngster one afternoon per week. The teacher brought along equipment from the school and attempted to extend into the child's home teaching on a one-to-one basis. Originally the mothers' role was that of being present and of observing. Over time, the project has moved to acquire a much more active interaction with the mother herself. On the Binet the first two groups showed an initial superiority after completion of one year in preschool as compared to a control group, but after that time the differences failed of significance. With the third wave, however, the superiority was maintained through the second year of the preschool. Perhaps a result of the more active role of the mother in the later groups, which in effect lengthened treatment time.

A second study by Weikart (1969) compares three curricula for young children, the study compared three curricula thought to be of possible value for the disadvantaged: 1) a "unit-based curriculum" which emphasized the socio-emotional development goals of the somewhat typical nursery school program. An effort was made to introduce children to the wider environment, to pay close attention to individual. social and emotional needs and to allow a high degree of permissiveness in classroom operation; 2) a "cognitively-oriented curriculum" following the one developed in the Perry Preschool Project over time. Weikart describes this as based on methods of "verbal bombardment", and socio-dramatic play and showing principles derived from Piaget's theory of intellectual development; 3) a language training curriculum emphasizing acquisition of academic skills. This last was the Bereiter-Engelmann approach. There was one group of three-year-olds and another group of four-year-olds. In addition, there was an appropriate control group. Although the number of cases is amall, there was a striking consistency in the two age groups. For the four-year-olds, gains for the three curriculum groups varied between 18 and 24 IQ points on the Binet, while the contrast group gain was only three points. With the younger children, the gains were between 28 and 30 with a 0.4 gain for the contrast group. One contrast group made virtually no gain and the other made what would be expected as a minimum gain on the basis of test-retest. The other striking finding, of course, is the lack of difference among the three curriculum groups. These findings suggest that the current search for specific curricula for disadvantaged children may be unnecessary.

Karnes (1969) has reported the findings on a three year study comparing five general approach-es to curricula for young, deprived children. One of these was the so-called Traditional nursery school, aimed to promote personal social skills and general language development of the children. A second was the Community Integrated program, which provided a traditional nursery school, but was operated by community groups and primarily came from middle and upper-class Caucasian parents. The third program was a Montessori-type program, which met Montessori standards. The fourth program was the "Ameliorative" program, which emphasized verbalization in connection with manipulating concrete material. Each classroom was divided into three subgroups, and structured learning experiences were devoted to math concepts, language arts and reading readiness, and social science studies. The last program was the Direct Instruction program, which was basically a Bereiter-Engelmann-type program. This program emphasized intensive oral drill, and verbal and logical patterns, with a general instructional strategy of learning a rule which was then followed by application. The arithmetic program emphasized a "science of counting" approach. The children were also taught to read with a modified Initial Teaching Alphabet. The subjects for Karnes' study came from economically depressed areas of Champaign-Urbana, Illinois. The mean IQ of the groups ranged from 93 to 96. The major intervention, which began at four years, lasted one year for the Traditional Community Integrated, and Montessori groups. The Ameliorative group, which along with the previous three, entered kindergarten at age five, received one hour a day instruction in addition during the kindergarten year. The Direct Instruction group did not attend the regular kindergarten, but instead continued in the Bereiter-Engelmann program. For first grade, all children attended the public schools of the city.

Data through the pre-school experience and through kindergarten are available only on the Traditional, the Ameliorative and the Direct Instruction groups. Karnes has based her evaluations on analyses of the results of the Binet, the ITPA, and when appropriate, tests of reading readiness and school achievement tests. At the end of the year of intervention, gains in the Traditional, Community Integrated and Montessori groups were approximately the same, from five to eight points. In the Ameliorative and Direct Instruction groups, gains were 13 and 14 points. During the second year in which the children entered regular kindergarten, with the sole exception of the Direct Instruction group, no gains were shown, not quite maintaining the level of the previous year. The Direct Instruction group, which continued in the Bereiter-Engelmann program, showed an additional gain of six points. The Traditional group, which had shown little gain, maintained its preschool level during first grade. Both the Ameliorative and Direct Instruction groups fell back somewhat, although the losses were slight.

Results of the ITPA are relatively complex. Briefly, the Direct Instruction and Ameliorative groups showed a modest amount of gain on the ITPA, while in active intervention. They tended to drop back somewhat, however, in first grade, so the three groups compared at this time were not significantly different on the ITPA. First grade achievement tests, on the California, showed the Ameliorative and Direct Instruction groups to be superior, with performance somewhat in advance of the actual expected mean score on the basis of grade placement. It is of interest to note that on the basis of actual skill performance the Ameliorative and the Direct Instruction groups performed in a similar fashion, both showing superior performance. Karnes' interpretation of this is somewhat similar to David Weikart's approach to the functionally equivalent curriculum.

Hodges, McCandless and Spicker (1967) have labeled their study: The development and evaluation of a diagnostically based curriculum for preschool psycho-socially deprived children. There were three groups of children in successive years beginning during the academic year 1964 to 1965. These came from rural and semi-rural southern Indiana. Comparisons were made across three groups: the "diagnostic" kindergarten, a regular kindergarten, and a no kindergarten group. The diagnostically based curriculum attempted to individualize instruction in terms of the children's scores on the language tests used,the ITPA and the PPVT, and upon the Oseretsky Test of Motor Development. Several other attempts were made to assess auditory and visual perception, articulation and the like. The attempt, to base a curriculum diagnostically, although praiseworthy, will be doomed because of the problems of effective differential diagnosis--i.e,, there must be effective differential treatments to follow upon the diagnosis. On the Binet, the ITPA and the PPVT, which were used as pre- and post-test measures, the group with the most gain was the diagnostically based curriculum, followed by the regular kindergarten, which in turn was superior to the control. Follow-up data are reported on the first two groups of children through the second grade, and on the third group through the first grade. Through the second grade the two groups of intervention children--diagnostically-based and regular kindergarten--maintained their gains.

By the end of second grade, however, the control children had caught up enough so that differences were no longer significant between the treatment groups and the control groups. Findings tended to be similar on the PPVT and on the ITPA. Follow-up information through the next year of schooling, particularly, is interesting as it relates to school failure or placement in special classes. The children in this study started from a relatively low baseline, with a mean IQ of 75. Failure and special classroom placement has been typical of the control groups. The experimental groups have tended to remain in the regular classroom with approximately two-thirds of them described as in this sense, successful. The one of the three groups with the best record is, interestingly enough, the second group which Spiker describes as having had the most directive intervention, probably most like the typical first grade in content. This means, if one has no control over the follow-on experience of the child, that preschool intervention has to be close to the actual school situation if it is to result in more effective school performance.

There are not many studies, that from reports seem to be well designed and executed, or are either not fully reported or are without sufficient time so far to judge results. Furthermore, in the few available studies, there is a great variation in the kinds of programs and of children, in the length of intervention, the techniques used and the length and frequency of follow-up testing. Even so, it may be helpful to look at relevant dimensions or findings from these studies and others for planning future intervention programs with young children.

For example, consider the age of intervention. It is no surprise that the programs that have intervened earlier have tended to show the greatest gain, at least temporarily. Studies beginning with four year olds show more gain than those beginning with five year olds. See for example the Weikart data, and the findings on the Early Training Project where the first experimental group tended to show greater gain during the intervention period than the second group, which began a year later.

Secondly, the initial ability level is another factor. In general, the programs that begin with children of IQs in the high 70's and the low 80's at initial testing have tended, at least on intelligence tests, to show more gain than those with higher IQs at initial testing, or with lower IQs. The Hodges, et al.children, for example, showed less gain than the Weikart children. The Weikart children have shown slightly more gain than the Early Training Project children, particularly in the Weikart's later waves. There may be a regression phenomenon here, but there is also a suggestion that programs currently planned to offset the environmental deficits of the disadvantaged seem to work best with children with a moderate but not great amount of retardation.

A third finding, although less clearly documented in these studies, but a prominent factor in the Skeels study and in some of the findings in the Early Training Project, is that of the degree of change in the on-going environment. The Skeels study has been, therefore, the most dramatic. The Early Training Project compared eight youngsters who moved into previously all white schools with comparable youngsters who remained in their original school which was nearly all Negro. Since the numbers are small, these findings are tentative. Still, it is interesting to note that the youngsters who moved tended over a three-year period to show, on the Metropolitan Achievement Test, approximately three years of gain--the progress of so-called normal children. Non-movers, children who were matched on such things as a general rating of the home situation, parental aspirations for the child, and first grade achievement level of the child, made only two years' progress in the three academic years.

Another interesting finding is that of what might be called delayed effects--ones that do not emerge immediately. In the Perry Project, experimental and control groups of the first wave were not significantly different on measures of intelligence at the end of the second year of intervention and at the end of kindergarten. These experimental youngsters, however, showed themselves superior on every subtest of the Gates Reading Test and the California Achievement Test at the end of first grade. Some of the Head Start follow-up studies suggest the same thing. For example, Hyman and Kliman (1967) have reported a study in which they found that Head Start children who entered a middle class public school sustained their gains over non-Head Starters, while similar Head Start children who went to a slum school did not maintain their gain. The Early Training Project found more significant differences between experimentals and controls on achievement tests at the end of second grade than at first. Possibly the experiences of the experimental children tended to define somewhat the curriculum of the first grade--that is, teachers concentrated on "bringing-up" the performance level of the non-experimental children particularly for those items on which the experimental children excel. It may well be that first grade or kindergarten, tends to be too similar to the intervention programs, and that it is only later that effects will show.

Another consideration touched upon briefly, is what Weikart (1969) terms the functionally equivalent curriculum program. The first part is the curriculum content. Each of his three curriculum approaches had a clear commitment to a given theoretical model. The models were different, but each provided a general conceptual framework within which the teacher operated. The second item was the general planning and implementation of the program. Lesson plans were based upon the specific goals of the theoretical framework. According to Weikart, implementing these plans was a daily struggle because it required a continuous review of curriculum effectiveness. Such a program inevitably demands great commitment on the part of the staff, and continual supervision. Third is program's operation, which includes the involvement of the mother, the specific focusing on the individual child, and the focusing on the child's educability. In all three curricula approaches there was a heavy emphasis on language.

Another relevant area is an emphasis upon the motivational component in sustaining a gain. Changes in attitudes and interests relating to school activities may have major effects over time.

Thus, the more effective programs of preschool intervention have placed a heavy emphasis on language, on providing and stimulating interaction with a rich environment, and a high degree of individualization of the program for the given child: combined they all serve to increase the child's general educability.

Probably among the most important aspects of the Weikart study and the Early Training Project is the nature of parent involvement. Weikart does not make a differential test of parent involvement, but the weekly home visits over the period of two years may well account for the size of gains that he has been able to demonstrate. The Early Training Project had about the same amount of parent involvement, but it was directed somewhat more directly toward bringing the parent into the situation as a teacher for her child than Weikart's was. Karnes' (1969) program has involved the parents in work in small groups. An important dividend in all of these might be the spillover effect on other children in the family. The research in which a group of George Peabody College has been engaged in the last three years has been designed actually to test comparisons of maximum involvement of mothers, a home visitor program for mothers, and a no-intervention for mothers but intervention for the target age child alone. The target age children in this study have completed first grade. The preliminary findings indicate that when children meet in small groups for four hours a day for forty weeks or more, additional emphasis upon the parent does not seem to affect the performance of the target age child appreciably. Marked differences occur, however, with the younger siblings of these children. Here it was found that with mothers involved in the program, the younger siblings are superior on intelligence tests and on a measure of concept development. These modest procedures are still a long way from typical parent education, which tends to be a fairly passive process of imparting information. The more active involvement of the parent seems to be imperative, at least in these cases.

It seems therefore, based on essentially limited preliminary data, that intervention programs can make a difference when carefully defined, implemented and assessed. It must be remembered that massive deprivation demands massive measures, and it demands these over time. The environment which created a deficit continues to take its toll after intervention ceases, unless the environment is improved. For the next few decades early intervention probably is the necessary condition for improving the educability of disadvantaged children, but it is certainly not a sufficient condition. The school, community, and home must work to sustain early gains, i.e., if children are not to fall behind as they move through their school years.

Mother-Child Relationship:

Even if major responsibility for the development of cultural-familial retardation is attributed to the environment, one cannot however, condemn the environment per se as the causative agent unless we specifically refer to those parts of the environment which have contributed the intellectual milieu necessary for the development of cognitive skills. Obviously, as has previously been noted, among the most significant agent in the physical environment of the child is the mother. Indeed, it is the very nature of the environment created by the mother which can determine the direction of the development of cognitive skills. Vygotsky (1962) holds that it is the interaction with the mother which is critical for the development of language skills and the interiorization of the speech processes essential to cognition. Hess and Shipman began in 1962 to study the nature of the parent-child interaction and its implications of this process for cognitive development. They were able to establish three typical patterns which characterize this interchange and also found a fairly consistent association of patterns with particular socio-economic levels in the population.

The major contention derived from their research is that it is the nature of the child's interactions with his world which determines the eventual style of his cognitive abilities. These interactions tend to elicit various response sequences which affect development of his thinking. In other words, the Hess-Shipman notion conceives of the mother as occupying the role of an educational engineer who programs the child's input and thereby initiates the sequence of behavior which shapes his style of strategy for information processing. A child must be able to selectively examine the incoming stimulation and make discriminations amongst the stimuli for the relevant or essential information, while disregarding the irrelevant. This ability is based in what the child has learned to expect through his experience, for which he must depend on the variety of stimulation that is presented to him by his mother. In effect, successive experiences with varied exteroceptive stimulation are accomplished successfully to the extent that previous experiences have prepared the child. The manner in which he deals with new input is determined by prior learning, and the skill developed may well determine whether the information is satisfactorily processed or overwhelming or meaningless.

Thus, the major argument made by Hess and Shipman (1968) is that cognitive development is based in the learning of strategies for processing information and dealing with the environment first learned in interaction with the mother. Furthermore, the extent to which they facilitate dealing with the environment depends on the range of alternatives of action and thought previously offered. However, these strategies for learning may be constricted by systems of control which offer predetermined solutions and few alternatives for consideration and choice.

On the basis of their investigations, Hess and Shipman (1967, 1968) established three characteristic patterns of regulatory control employed by the mother in her interaction with the child:

1) Imperative-Normative: This type of control by the mother uses social norms for control of the child, and makes appeals to do what is "right" or don't do what is "wrong." It is a system of control based on non-rational appeals, such as the appeals to power and/or authority: e.g., "You'll do that because I told you to." This system does not require either complex linguistic communication or provide much opportunity for reflective thought.

2) Personal-Subjective: Mothers using this type of control modify their appeals to authority by calling attention to the feelings of other, intentions, motivations. For example: "You shouldn't say things like that--they hurt your sister's feelings." By appealing to inter-personal comfort this manner of control by the mother requires and encourages more complex communication. It broadens the range of cues (information) to which the child must attend than does an appeal to norms.

3) Cognitive-Rational: In this system of regulatory control, the mother appeals to long range goals, or employs reasoning in making demands or stating rules. For example, "If you eat cookies now, you won't eat your dinner." Such explanations require of the child much more complex communicative ability and reflection than either of the other types of control. The child "...must attend to a sequence of ideas and observe the relationships of events which though separated in time, are brought together in anticipation of alternative consequences which may be expected to follow different immediate actions.", (Hess and Shipman, 1968, p. 94). In this interaction pattern, the child is oriented to the future and toward symbol manipulation and therefore requires considerably more cognitive activity than in either of the other systems of control.

The complexity of the communication language necessary to complete the interaction between the mother and child varies between systems. The role of this language system is critical to the child's cognitive development. Bernstein (1961) has characterized the communication mode of the mother as either elaborated or restricted:

a) Restricted communications: "...are stereotyped, limited and condensed, lacking in specificity and the exactness needed for precise conceptualization and differentiation." Sentences are short, simple, of ten unfinished. There is little use of subordinate clauses for elaborating the content of the sentence; it is a language of implicit meaning, easily understood and commonly shared. This mode effectively limits the variety and detail of the information and concept involved in the communication.

b) Elaborated communications: Communications of this type are individualized and the message is specific to a particular situation, topic and person. They are more particular, more differentiated and more precise. They permit expression of a wider and more complex range of though, tending toward discrimination among cognitive and effective content.

In essence, it is the mother's linguistic and regulatory behavior which induces and shapes the information-processing strategies and styles in her child. Moreover, the concept of Hess and Shipman requires a consideration of the motivational nature of the interaction between the mother and child, which effectively determines the child's tendency to either be assertive and to demonstrate initiative in dealing with incoming information, or rather to be passive and compliant to new experiences. Mothers, whose regulatory control system appeals to authority and/or norms induce passive cognitive styles and tendencies to be non-reflective in thought, particularly where communication modes are restricted. Further, the child which experiences this type of regulatory system tends to develop a weak self-concept, low motivation and low self-confidence.

Hess and Shipman have found the development of the passive-compliant style of cognition in children is related to low socio-economic status mothers, particularly those with low IQs. These mothers were found to have the lowest verbal output, and tended to use imperative statements. Also, the child's performance on various cognitive tasks was found to be highly correlated with these maternal behavioral variables. Indeed, Hess and Shipman go so far as to say that the learning styles and information processing strategies that the child develops in the early interactions with the mother may limit the potential mental growth of the child unless an intervention program is instituted which resocializes or re-educates the child toward more effective cognitive strategies. An intervention program might in other words mitigate the effects of the constricted intellectual milieu created by the mother for the child and offer a variety of alternatives for action as well as ample opportunities for expression and reflection.

The nature of the disadvantaged child's interaction with the mother using imperatives as a control system stultifies intellectual growth and the interiorization of the speech process as language facility develops. With this general process of cognitive development blocked at a particularly early age, subsequent intellectual demands are not met adequately because of poor development of basic intellectual skills. Not only are such challenges not met, but there is, as the child develops, an increasing discrepancy between his intellectual capacities and the complexity of the tasks he is expected to accomplish. The resultant is manifest as a slow but steady decline in the IQ to levels of his intellectual peer--his mother. However, this may not always be the case and there may indeed be some manner in which early diagnosis of a lag in the development of cognitive abilities can be remediated by early intervention.

Thus, the effects of the mother and child's interaction are far reaching. Not only does it influence the child's cognitive development, but it is a powerful influence on his personality. The passive-compliant attitude induced in the child by the constricted communication of imperatives as a means of regulatory control weakens self-confidence and dampens motivation. Moreso, this developmental style is detrimental to the child's educability because it retards the development of cognitive skills, dampens motivation to achieve and destroys the understanding of the child's appreciation of the teacher-pupil relationship and the authority system of the school. The mother effectually orients the child toward a behavior pattern of failure as a function of the poor development of his motivation to succeed. The disadvantaged child's home life - interaction with his mother, in the early years of development - effectively retards the child's cognitive development (Hess and Shipman, 1967) and the ramifications of this impairment in the child's development are manifest as deficiencies in all realms of cognition.

Detection and Diagnosis

Probably part of the responsibility for the problem of cultural-familial retardation is the overwhelming difficulties associated with identifying the retardate or, moreso, identifying the potential retardate. A major problem is, as we discussed earlier, that most often cultural-familial mental retardation is detected only after the child has entered school, and then it is not necessarily properly diagnosed. If a child is diagnosed as mentally retarded it is likely due to rather conspicuous abnormal functioning, since children are neither regularly tested for intellectual development, and the symptoms of cultural-familial retardation are not manifest until the child is challenged to perform within a formal school system.

As we have seen from our discussion, the problems of cultural-familial retardation reduced the value of retrospective diagnosis--i.e., diagnosis that waits upon the overt manifestations of an illness. Indeed, as has been the case, such techniques have resulted in merely treating symptoms of cultural-familial retardation which unfortunately are at point where there can not be complete amelioration of the effects, if any at all. Indeed, the very nature of C-F retardation requires that diagnosis be made as early in the developmental process as is possible. Certainly, there are limiting conditions but there is a technique by which the problems of detection and diagnosis may be surmountable.

As discussed in the previous section, faced with the problem of early detection of mental retardation, the University of Wisconsin Research and Training Center established the High-Risk Population Laboratory. The main purpose of this effort was to provide opportunity for prospective longitudinal investigation into the problems of mental retardation, in contradistinction to the almost exclusive reliance upon retrospective techniques. Further, the intent of the laboratory was to bring into accessibility for research purposes the sub-population of the mentally retarded labelled the cultural-familial retarded, which previously has been essentially unavailable to investigators. This group of retarded reside in the community and remain undetected for 2 reasons: 1) they have relatively mild intellectual deficits which are most difficult to detect in the very young; and 2) are without major related physical problems. Ordinarily, either of these characteristics alone would be sufficient to precipitate the attention of responsible agencies to these individuals. Thus, the approach used by the High-Risk Population Laboratory unit, needed not only a technique for early detection, but needed to provide sufficient information to permit the diagnosis of cultural-familial retardation.

In order to establish the "high-risk" population laboratory, a door-to-door survey was conducted in an area of the metropolitan community of Milwaukee which has previously been identified as having an extremely high prevalence of retardation. This area of the city has the lowest median educational level, and the highest rate of dilapidated housing in the city.

Though the area comprises about 2 1/2% of the population of the city, it yielded approximately 1/3 of the total number of children identified in school as educable mentally retarded. All members of the family, both children and adults, received an individual intellectual appraisal. In addition, extensive data were obtained on family history and on social, educational and occupational history and status. This technique provided a data pool which has been used as the basis for selection of samples of selected characteristics of a population of mentally retarded, which included young adults, and their offspring, who are "at risk." Furthermore, it has provided us with some key variables that appear to be sufficiently sensitive to the existence of cultural-familial retardation to be used as a signal for such.

The population survey data produced some striking data on the prevalence of retardation in depressed urban areas, on the distribution of retardation among families living in the high-risk area, and on trends in intelligence as a function of age of children and adults residing in the area. Some of this information we have previously discussed. For example, it was found that the high prevalence of mental retardation identified with Milwaukee's inner core population was strikingly concentrated among families where maternal intelligence was depressed, particularly where the family was large. The prevalence of IQ's of 75 and below is 22% for children in families where there was a newborn and at least one child of age six or greater. This selection procedure resulted in a sample of much larger than average families, and an increased prevalence of sub-75 IQ's. However, it was found that 45.4% of the mothers who had IQ's below 80 accounted for 78.2% of all children with IQ's below 80. Moreover, it was found that depressed maternal intelligence was a better predictor of depressed child intelligence for older than for younger children. However, the more startling aspect of this data is that on infant intelligence tests, children of mothers above 80 IQ and below 80 IQ did about equally well. After the infancy period, though, the children whose mothers had IQs greater than 80 appeared to maintain a fairly steady intellectual level, while the children whose mothers had IQs less than 80 exhibit a marked progressive decline in the intellectual level. This trend toward a decline in measured intelligence for children in disadvantaged environments has wide acceptance as a general characteristic of a "slum" environment population, although this set of data indicates that this trend of declining intelligence as age increases is restricted to offspring of the "less bright" mothers.

These survey data seriously question the adequacy of the view that the "disadvantaged" environment in some very generic way affects cognitive development adversely. In fact, these data challenge the adequacy of many of the social, education and rehabilitative programs which presently impinge upon depressed areas in the cities. The reason for this is that many of these programs are based on the assumption of a uniformly depressing effect of "city slums" on intellectual development and, in interpreting the data on intellectual development in "slum" populations, have tended to ignore the fact that there is a continuum of intelligence within a socio-economic grouping and different distributions of intelligence for sub-groups within the "slum-dwelling" population. Indeed, the data suggest that rather than a general low SES population phenomenon, the determinants of the prevalence of mental retardation among disadvantaged population groups is a function of large within family variation. Therefore, in the light of our previous discussion of early development and the significance of the mother-child interaction and the survey data indicating a striking concentration of mental retardation among those disadvantaged families where there were many siblings, and where maternal intelligence is depressed, there can be only one conclusion: there is a need for a comprehensive total family approach to rehabilitation and prevention of retardation which revolves mainly about the mother and the child.

Summary

Obviously the mitigation of environmental factors which may be pertinent to cultural-familial retardation is a consequence which cannot be accomplished by any single source. It is not practical or ethical to have each child's early developmental needs cared for from birth to school age by some extra-familial institution. Furthermore, there is now a large population of mothers who are ignorant of the critical nature of early childhood and also ignorant of their own needs during pregnancy. Thus, these mothers are consequently potential contributors to the growing numbers of children at risk for mental retardation. Therefore, early stimulation programs notwithstanding, there is a considerable need for a massive, comprehensive, perhaps nation-wide program for the prevention of mental retardation.

The basis of this effort should be an intensive education program. It should avoid the typically passive program, exemplified by the use of such things as: so-called informative messages splashed on television; having social workers and nurses on their infrequent home visits leave never-to-be-perused literature; or relying simply on the mild rebukes of young interns to mothers probably seen for the first time the night of delivery, etc. If these are the techniques of prevention, then there can never be enough money for funding projects to combat this problem. It is not the problem of the poor, and not the problem of the welfare agencies--it is society's problem and it must be carried on through a community government.

However, an extremely important aspect of any community program concerned with this problem is that it must be fully aware that previous identification of such people was hampered, because of lack of education amongst "slum dwelling" retarded adults, or because there has been insufficient motivation to seek out, participate in, or profit from the usual rehabilitative resources in the community or even because of hostility on the part of this population of retardates toward community facilities. In other words, these people must be actively sought out and helped to understand the nature and significance of the program. There are no electronic machines to be plugged in or turned on, rather the implementation of this program with all consideration for success will require an active community service program for which there probably is no previous model.

The Milwaukee family intervention project reported in this monograph is designed to provide and test a miniature model for a program of this kind in terms of its effectiveness in preventing the perpetuation of mental retardation among offspring of "high-risk" families. Secondarily, it is hoped that the research data will contribute to achievement of a better understanding of the etiological determinants of cultural-familial mental retardation and of the means for its prevention.

References

Ambrose, J. A. The development of the smiling response in early infancy. In B. M. Foss (Ed.), Determinants of infant behavior, New York: Wiley, 1961, 179-195.

Birch, H. G., 1967.

Bowlby, J. Separation anxiety. International Journal of Psychoanalysis, 1960, 41, 1-25.

Brock, 1961.

Burt, C., The genetic determination of differences in intelligence: A study of monozygatic twins reared together and apart. British Journal of Psychology, 1966, 57, 137-153.

Craviato, J.; DeLicarde, E.R.; Birch, H.G. Nutrition, growth and neuro-integrative development: An experimental and ecologic study. Pediatrics, 1966, 38, 319-372.

Denenberg, V. H. Stimulation in infancy, emotional reactivity, and exploratory behavior. In D. H. Glass (Ed.), Biology and behavior: Neurophysiology and Emotion. New York: Russell Sage Foundation and Rockefeller University Press, 1967.

Dennis, W. Causes of retardation among institutional children: translation J. Genetic Psychology, 1960, 96, 47-59.

Densen and Hayes, 1967

Erlenmeyer-Kimling, L., and Tarvik, L.F. Genetics and intelligence: a review. Science, 1963, 142, 1477-1479.

Fanty, R. L. Visual perception from birth as shown by pattern selectivity. Annals of the New York Academy of Sciences, 1965, 118, 793-814.

Fry, D. B. The development of the phonological system in the normal and the deaf child. In Smith, F. & Miller (Eds), The Genesis of Language: M.I.T. Press, 1966.

Gewirtz, J. L., The course of infant smiling in four child-rearing environments in Israel. In B.M. Foss (Ed.), Determinants of Infant Behavior. New York: Wiley, 1965.

Heber, R.F. and Dever, R. B. Research on education and habilitation of the mentally retarded. Presented at George Peabody College, Nashville, Tennessee, 1968.

Heber, R.F., Dever, R.B., and Conry, T. The influence of environmental and genetic variables on intellectual development. In Prehm, J.J., Hammerlynck, L.A. and Crosson, J.E., (Eds.), Behavioral Research in Mental Retardation, Research and Training Center, Monograph 1, University of Oregon, 1968

Hodges, W.L., McCandless, B.R., Spicker, H.H. The development and analysis of a diagnostically based curriculum for psycho-socially disadvantaged children. Final report, Indiana U., Contract No. OEG-32-24-0210-1011, U.S. Office of Education.

Kirk, S.A. Early Education for the Retarded. Urbana, Illinois: University of Illinois Press, 1958.

Klaus, R.A. and Gray,S.W. The early training project: a report after five years. Monographs of the Society for Research in Child Development, 1968, 33, (4, Serial No. 120).

Garber, Heber

Lipsitt, L.P. Learning processes of human newborns. Merrill-Palmer Quarterly of Behavior and Development, 1966, 12, 45-71.

Lipsitt, L.P. Learning in the human infant. In H.W. Stevenson, E.H. Hess, and H.L. Rheingold (Eds.), Early behavior: Comparative and developmental approaches. New York: Wiley, 1967, 225-247.

McGraw, M.B. Later development of children specially trained during infancy. Child Development, 1939, 10, 1-19.

Papousek, H. Experimental studies in appetitional behavior in human newborns and infants. In H.W. Stevenson, E.H.Hess, and H.L. Rheingold (Eds.), Early behavior: Comparative and and developmental approaches. New York: Wiley, 1967, 249-277.

Riesen, A.H. Stimulation as a requirement for growth and function in behavioral development. In D.W. Fiske andS.R. Maddi (Eds.) Functions of varied experience. Homewood, Illinois: Dorsey, 1961, 57-80.

Schaffer, H.R. Objective observations of personality development in early infancy. British Journal of Medical Psychology, 1958, 31, 174-183.

Skeels, H.M. Adult status of children with contrasting early life experiences. A follow-up study. Monographs of the Society for Research in Child Development, 1966, 31, (3, Serial No. 105).

Skeels, H.M. and Dye, H.B. A study of the effects of differential stimulation on mentally retarded children. Proceedings and addresses of the American Association of Mental Deficiency, 1939, 44, 114-136.

Skodak, M. Children in foster homes: A study of mental development. University of Iowa Studies in Child Welfare, 1939, 16 (1).

Skodak, M. & Skeels, H.M. A final follow-up study of one hundred adopted children. Journal of Genetic Psychology, 1949, 75, 85-125.

Spitz, R.A. Hospitalism: An inquiry into the genesis of psychiatric conditions in early childhood. In O. Fenechel et al. (Eds.), The Psychoanalytic Study of the Child. New York: International Universities Press, 1945.

Spitz, R.A. Hospitalism: A follow-up report on investigation described in Vol. I, 1945. In O. Fenechel et al. (Eds.), The Psychoanalytic Study of the Child, 2, 113-117. New York: International Universities Press, 1946.

Spitz, R.A. & Wolf, K.M. The smiling response: A contribution to the ontogenesis of social relations. Genetic Psychology Monographs, 1946, 34, 57-125.

Weikart, D.P. (Ed.), Preschool intervention: A preliminary report of the Perry Preschool Project: Ann Arbor, Michigan: Campus Publisher, 1967.

Yarrow, L.J. Separation from parents during early childhood. In M.L. Hoffman and L.W. Hoffman (Eds.), Review of Child Development Research. New York: Russell Sage Foundation, 1964, 89-136.

III

The Project Design and Family Intervention Program

Selection of Research Families

As described in the Introduction section, a set of contiguous census tracts was selected for purposes of conducting a series of "high-risk" population surveys. This area also comprised the area from which the sample was drawn for purposes of this study. In brief, this area comprised about 2 1/2% of the population of Milwaukee but yielded about one-third of the site's identified educable retarded children of school age. According to 1960 U. S. Census Bureau data, the tracts comprising this area were rated in the lowest category (for Milwaukee) in terms of median educational level and income, and in the highest category in terms of population density per living unit, percent housing rated as dilapidated and unemployment.

This area was designated as a "high-risk" residential area. To identify "high-risk" families within the sample area, the variable of maternal intelligence was utilized as a selection criterion (maternal intelligence having proven to be the most efficient predictor of low school-age offspring intelligence (see population survey data described in Introduction).

Trained interviewers visited all mothers of newborns residing in the prescribed sample area (described in the Introduction). These interviewers used the Peabody Picture Vocabulary Test (PPVT) as an initial screening device and also collected extensive family history data. (See Appendix for sample of survey instrument). Raw scores on the PPVT of 70 or less were followed up with a full-scale WAIS administered, again, by trained examiners.

From a final pool of candidates composed of mothers with full-scale WAIS IQs of 75 or less, we randomly assigned these mothers to either the experimental or control condition after they had been invited to participate in a study of children's develcpment being conducted by the University of Wisconsin.

Forty mothers meeting this WAIS IQ criterion residing in the sample area had babies over an eighteen month period and were assigned as either experimental or control families.

One deviation from random assignment occurred as follows: infants were assigned to E or C conditions in groups of three or four because of the greater feasibility of adding infants to the stimulation program in small groups in view of staffing requirements, etc. Thus the first few families meeting selection criteria were assigned to the E condition, the next group to the C condition and so on until 20 families were accumulated and assigned to each condition. A further restriction imposed to increase homogeneity of the small samples was that all families selected were of Negro extraction.

The experimental intervention is comprised of two components: 1) the infant stimulation program and the maternal rehabilitation program which are described below:

The Infant Stimulation Program

The program is, in its most basic sense, designed to facilitate intellectual development of very young children. The plan is concerned with: 1) a staff to manage and arrange instruction for children; 2) a physical location which promotes learning; and 3) the stimulation program.

The Staff

At the onset of the stimulation program we chose to employ a paraprofessional staff. The persons chosen were, in our judgment, language facile, affectionate people who had had some experience with infants or young children. The majority of these "teachers" resided in the same general neighborhood as the children, thus sharing a similar cultural milieu. The teachers ranged in age from approximately 18 to 45 with most of the teachers in their mid 20's. Their educational experience ranged from eighth grade to one year of college.

The job of the teacher within the educational setting can be most difficult since it requires contact and communication with not only the children but with other teachers, supervisors and parents.

Contact with Children

When a child entered the project at three months of age, he was assigned a teacher. If this match proved satisfactory, the child remained with her as his primary teacher until he reached 12 to 15 months of age. At that time the child was gradually paired with other teachers and children. By the time he was 15 to 20 months old, depending on the child, he was grouped with two other children and coming into contact with three different teachers. This situation holds for just his academic-learning environment. Actually each child was in contact with most of the other children and teachers.

The teacher who was assigned to an infant was responsible for his total care, including: feeding and bathing, cuddling and soothing, reporting and recording general health as well as organizing his learning environment and implementing the educational program. Within the context of the educational program, the teacher was expected to follow and expand upon a prescribed set of activities. Her job was to make these activities interesting, exciting and varied within the limits of the child's general routine; viz, eating, sleeping and activity. She was also required to "objectively" evaluate and report the child's progress, pointing out areas of apparent difficulty.

Each teacher of the young children's group (18 months and older) was generally responsible for approximately ten children, who she saw in academic groups of 2, 3, or 4 depending on their age. The teacher was not responsible for total programming, but was required to familiarize herself with one of the three main academic areas (math/problem solving, language, reading). She was trained to ahve a working knowledge of the major goals within her area and to define behavioral objectives. She was encouraged to utilize relevant, motivating activities that facilitated meeting her objectives. Moreover she was expected to evaluate each child's progress and individualize instruction accordingly. The three teachers in each class room shared the responsibility for additional subject areas and activities such as art, music, field trips, special holiday activities, etc.

Contact with Teachers

Teachers within any given classroom had also to decide upon the methods of behavior control so that, generally speaking, each child's specific problem would be handled consistently by all. This required merely a consensus of opinion on what behavior would be acceptable and what behavior unacceptable during a given portion of the day. Obviously, this consideration was made with a view toward what are realistic expectations for any given child. It was important for teachers to share this responsibility for one another as well as for the children.

While at times it was difficult for three teachers of equal status to share a room, we felt that this arrangement had two main advantages: 1) one advantage was a sort of protection device for the children. With a choice of adults in the room, it was hoped that each child would find a responsive adult to whom he could relate; and 2) secondly, this system provided a necessary option of relief time for a teacher on a regular basis, and allowed her to minimize her contact with children on days she was impatient.

Contact with Supervisors

A teacher was responsible to both the school supervisor and the curriculum supervisors. She was observed by both and was expected to consider criticism as constructive, to be flexible, and to ask for help when needed as well as to voice her own opinions, raise objections and offer suggestions.

Contact with Parents

Finally, the teacher of an infant had the major responsibility of establishing initial rapport with the infant's mother. This was done during a brief period of 2 to 8 weeks when the teacher worked with her child in the home until the mother expressed enough confidence in the teacher to allow the child to go to the center. This type of approach was necessary only with the first contact with a family. Subsequent younger siblings enter the center without the home adjustment period and neither the parent or the child seemed to suffer ill effects.

Teachers of the older children, especially those who provided the program's transportation, are in a unique position to maintain communication between the parents and the school. Daily contact between some parents and teachers provided the opportunity for teachers to relate John's ability to write the word "car", or to comment on Pat's fingerpainting. This emphasis on the positive demonstrated to the parent the teacher's concern for her child and often resulted in a parent becoming more receptive to information which sometimes is unpleasant for a parent to hear.

Training Program

It can be seen from the above that the responsibilities of our teachers were diversified and demanding. In order to prepare persons to successfully meet these requirements, an on-going training program had to be established.

The most important aspect of this program was the in-service training. Each infant's teacher was given help in organizing her day into blocks of time which included physical care and comfort as well as instructional blocks. Each teacher was provided with activities appropriate for his child. Each teacher was observed and evaluated frequently by a curriculum supervisor. Issues relating specifically to that teacher such as choice of activity, attitude toward the child, time spent in talking to the child, observation and evaluation were discussed privately with her. General problem areas were discussed with the entire group. During this time, problems were brought up both by the curriculum supervisor and the teachers.

As the children became older and teachers mastered one subject area under the direction of the curriculum supervisors, specific activity lists became unnecessary, except as guidelines or suggestions. In fact, teachers became quite competent in designing goal specific tasks independently. Group meetings continued to be valuable for exchanging ideas and helped to keep teachers on target in their academic areas. Also, they provided the curriculum supervisor with insight into attitudes and opinions of the teachers as well as into potential problem areas. Over the years such problems as toilet training, thumb sucking, 360 ways to teach colors, discipline, and children's rights have been discussed. More abstract topics such as how a teacher's attitude toward school may effect the child's attitude; ways a teacher transfers her attitudes; children's concepts of work and play within the learning environment; capitalizing on learning from peers; have also been brought up for discussion. This type of on-going training has been extremely valuable and necessary.

A second form of training is the teacher seminar which occurs once a year. This has usually taken the form of a two or three day conference at the University of Wisconsin in Madison. The program is comprised of guest speakers, large and small group discussion, in depth teacher and child evaluation sessions, workshops, and visitations. The topics for discussion are chosen by the teachers and the curriculum supervisor.

Early in the teacher's training, it was difficult to find preschool educators who espoused the views of a planned, structured approach to learning. By far, the predominant idea of preschool education was that it be a mixture of free play and storytelling. This contributed to much discussion with our teachers about why our program was not play oriented like the typical nursery schools and day care centers which they had seen or which their own children had attended. At this point in our development, with every teacher having been with the program for at least two years and observed the performance of the children, our teachers understand the uniqueness of our program and the reason for its structure.

This form of training, in comparison to solely relying on in-service training, has its value in providing an opportunity to view different programs; to hear new ideas and to evaluate our own children and program in depth apart from our own immediate situation. Further it had considerable value as a motivational technique. Following their participation in the seminar, the teachers were eager to try new methods. They spent more time discussing and evaluating their lessons and the children's progress.

Problems

Throughout the course of the project, the supervisory staff has had to deal with a variety of problems. The types of problems divide themselves essentially into three areas: 1) discipline, 2) teacher/supervisor communication, and 3) the academic learning situation.

1) The teachers and the supervisory staff discussed effective and appropriate methods of discipline. A more or less traditional approach of ignoring the child who, for example tries out the proverbial "four letter word" would not be used by most of our teachers, who would rather use a more active, direct approach. An even more important issue seems to be that of defining those behaviors which require disciplinary intervention at all. For example, the supervisory staff felt that requiring children to walk in a straight line on the way to lunch was unnecessarily restrictive; however, a number of teachers equated such behavior with the concept of school and felt such behavior should be disciplined.

2) Frequently teacher/supervisor communication is impeded because of an initial reluctance on the part of the teacher to disagree _openly_ with a supervisor and/or to take the initiative to make suggestions or changes.

3) Within the academic learning situation there was a tendency for teachers to fall into the use of a predominantly direct teaching method. In other words, we found teachers tended to talk _at_ rather than with children, or to simply dominate the verbal scene. Further, teachers would sometimes ask direct questions and accept only one answer. Teachers frequently needed to be reminded that children learn at different rates and that it was the _teacher's_ responsibility to gear the tasks appropriately for each individual, rather

than to expect the children to conform to the one approach or task set up by the teacher.

Although many of these problems are not seen daily or even monthly, they do occur often enough and are important enough so that they must be dealt with immediately.

Suggestions

Over the years the teachers and the supervisory staff have exchanged ideas each experiencing a near metamorphosis. In order to reach this level, constant communication was essential. But this flow of ideas is impossible unless the participants share certain basic tenets about children and learning. Furthermore, all must be flexible and creative, coming to this educational experience with an open, but organized, mind. Therefore, one of the most important ingredients for a successful program is the choice of a staff.

At the beginnings of the project 20 teachers were employed to care for the first 20 infants. Now that we have 25 children who range in age from 2 to 5, 9 teachers are employed to work directly with the children. Some of these teachers have been chosen from the original group while others, including one certified teacher, have been employed more recently. Over time the supervisory staff learned a great deal about the make up of a good teacher in this type of situation. The following is an outline of a technique which although it was not used in our project, might be helpful to others choosing a teaching staff for an early education program. It is not intended to be complete, but only to suggest an approach.

I. Choosing a teacher

  A. The Interview

    1. Why is the person interested in this type of job
    2. Experience with children
    3. Evaluate verbal ability
      a. organization of thoughts
      b. vocabulary
      c. amount of verbal response
      d. is this person well spoken
        (1) not necessarily in reference to perfect or constant use of formal English
        (2) do consider the number of people on the staff who do use formal English if appropriate

4. Provide verbal situations to determine attitudes and abilities
    a. approach toward discipline and general behavior problems.
        (1) What would you do if two children were fighting over a truck. Why?

        (2) How would you feel if one child announced to three separate visitors on the same day that you wore a wig? What would you do?

        (3) Which is more important or which would you deal with first . . .

        (4) In which of the following situations would you intervene . . . Why? Why not? How?

    b. organizing a learning environment
        (1) How would you teach Johnny to match colors?

        (2) Which would you teach first . . .

        (3) Which two of the following concepts would you choose to teach in the same day? . . .

        (4) Everyone except Johnny can make up a story about a picture. How can you help Johnny?

        (5) No one in your group remembers the names of the letters D, E, and M and you taught them yesterday. What do you do? How do you feel?

    c. attitude toward authority
        (1) Your supervisor disagrees with your choice of a lesson to teach rhyming words. She or he has always said if you disagree, say so. How do you feel? What do you do?

    d. attitude toward school
        (1) Educational experience

        (2) How would you change your school if you were principal?

        (3) If it were completely up to you how many years would you choose to attend school?

        (4) How many teachers do you remember in elementary school? Describe what they were like.

B. Observation

1. Evaluate each potential teacher's ability to define, describe and evaluate what she has seen in a pre-

school classroom, a playground situation, or in a mother/child or mother/infant interaction.

a. After a ten minute session
   (1) What did you see happen?

   (2) What were the children doing?

   (3) What was the teacher doing?

   (4) What did you like? dislike?

   (5) What would you have done if you were with those children?

   (6) What would you have changed?

2. Observe the potential teacher in an actual play or teaching situation with children.

C. Trial Period

1. Trial period of one to six months during which the teacher undergoes training and closely supervised teaching. At the end of this period the teacher is evaluated by the supervisor and the other teachers.

D. Points to Ponder

1. It is possible for an infant teacher to successfully become the teacher of young children even though the responsibilities of each position differ. Consider these differences when choosing a staff.

2. Use the general philosophy of the supervisory staff as a guide when hiring a teacher, but avoid choosing a staff with ideas which duplicate the supervisor's. This makes for a potentially sterile program which might not reflect the needs of the specific childhood population you serve.

3. There is nothing wrong with hiring certified experienced teachers providing they are flexible, open to new ideas and can work closely on an equal basis with other teachers.

4. All teachers, untrained or certified, should still participate in an ongoing training and evaluation program.

5. All adults do not interact in the same way; all teachers do not approach teaching in the same way; all children should not be taught and will not learn in the same way. Diversity in a staff will better prepare young children for school and life.

Physical Plant

Over the years, the project has been located in several facilities.

When all of the children were around six months of age, large 14 room duplex served our needs very well because of the many "nooks and crannies" where teachers could work with children on a very intimate one-to-one basis.

Later, when the children became increasingly mobile, a portion of the project was moved to a nearby Salvation Army Center. This afforded a large open space for gross motor activities, as well as several adjacent rooms for quiet instruction. The entire program is now housed in a leased school facility located adjacent to one of the inner-city's churches. This building, complete with six classrooms, a gymnasium, office space and a lunch room is no longer used for church school purposes, but is well suited for the needs of the program. (See Figure 2)

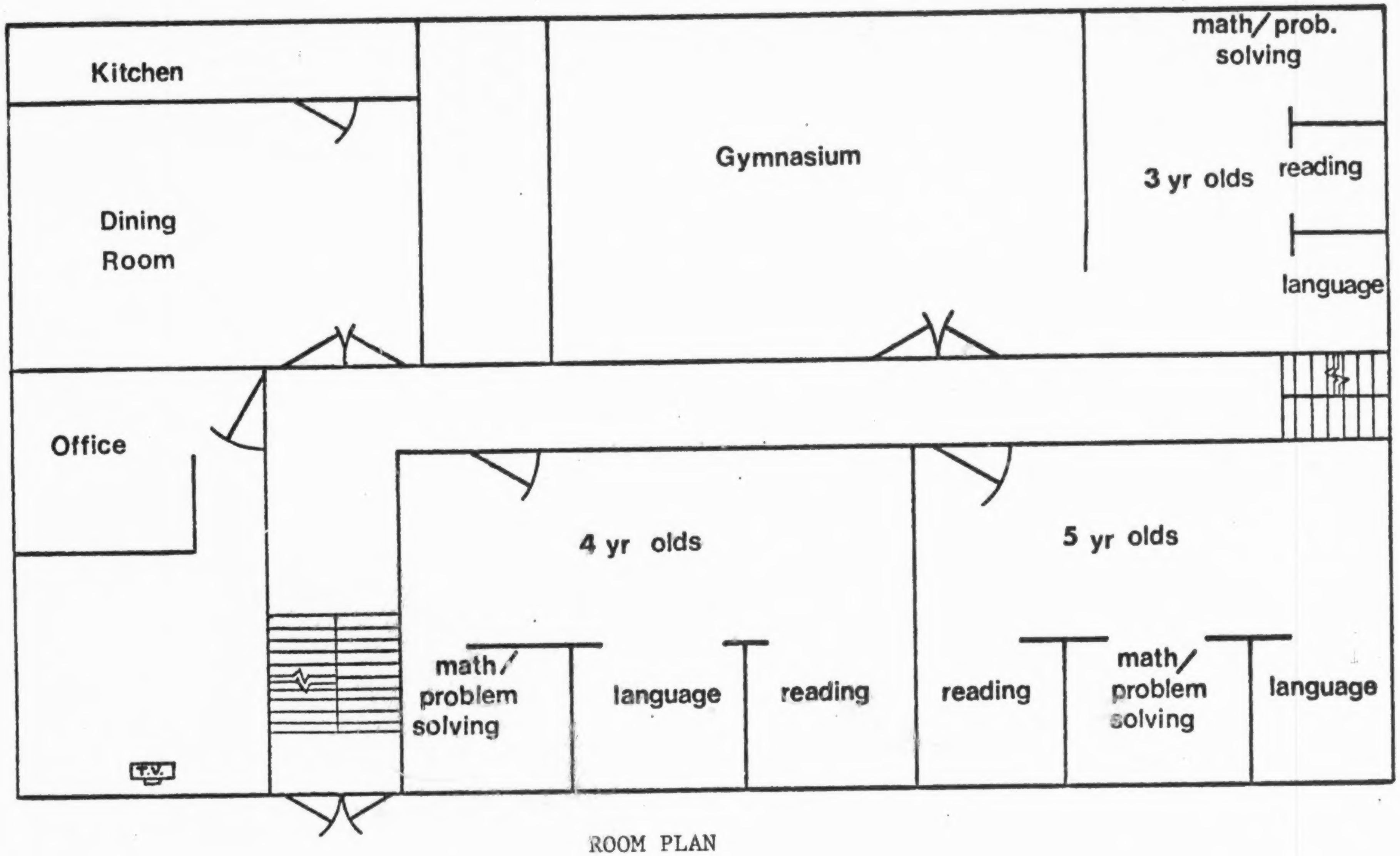
EDUCATIONAL PROGRAM

Philosophy

The overall goal of any educational program should be to provide an environment and a set of experiences which would allow children to develop to their potential intellectually as well as socially, emotionally and physically. The specific focus of the educational program was to prevent from occurring those language, problem solving and achievement motivation deficits which are known to be common attributes of mild mental retardation. We viewed intellectual functioning as the combination of abilities referred to as input, retention, interpretation, integration and utilization of symbols. The specific subject areas of our academic program are simply vehicles through which we hoped to foster in our children these abilities which underly normal intellectual development.

Implementation

The general educational program is best characterized as having a cognitive-language orientation implemented through a structured environment by prescriptive teaching techniques on a daily basis (7 hour per day, 5 day per week). This program and schedule was coupled with a high teacher-child


Kitchen
Dining Room
Gymnasium
math/prob. solving
3 yr olds
reading
language
Office
T.V.
4 yr olds
math/ problem solving
language
reading
5 yr olds
reading
math/ problem solving
language

ROOM PLAN

FIGURE 2

ratio, affording an opportunity to present a variety of cognitive tasks; to evaluate their effectiveness; and to provide both direct and non-direct teaching within both small and large groups.

Theoretical Approach

Although there are many theories which have implications for an educational program; e.g., Skinner, Piaget, Montessori, Bruner; none is complete while all are relevant. By necessity, the theory which has guided the development of the curriculum for the Milwaukee Project's Educational Program is eclectic yet structured in its presentation. There were no suitable programs available as guides for intervention in the first few months of life. Consequently, the project staff has continually adapted existing methods and materials to create a new one for the purposes of our program.

The educational program had two major emphases: 1) language and 2) cognition. Language we considered the ability to manipulate symbols and the tool by which one stores and recovers information, solves problems, interprets his environment and communicates. The development of language is suggested to proceed in relatively well-defined stages, although the mechanism responsible for this progression from stage to stage remains in the realm of theory. It was our intent that tasks or experiences could be presented to the child with considerable emphasis on verbal expressiveness in order to facilitate this progression.

The term "cognitive development" is just as elusive, theoretically. It is because cognitive development is viewed simultaneously as a process through which knowledge is acquired as well as the sum of knowledge acquired that causes so much difficulty. It is not enough to simply identify and provide children with the facts which potential school achievers are supposed to acquire by age five. A child must have at his disposal the technique not only to incorporate, integrate, refine, and utilize this information, but to act spontaneously whenever this situation changes.

While it is unlikely that cognitive development proceeds in sequential stages mechanistically, there are certain identifiable developmental landmarks or cognitive skills; e.g., sensory stimulation, discrimination learning, classification, association, generalization, integration, interpretation. We have focused on these and have attempted to facilitate their development by incorporating into the educational program specific tasks which are begun as soon as the children enter the program. The task is designed to strengthen the skill to be developed by developmentally complexing the task.

To recapitulate, language is emphasized for it is a tool for recording and processing information as well as for communication. Cognitive development is emphasized for it provides the child with a repertoire of responses enabling him to interpret and refine information. In addition, the child must have the desire to utilize these skills.

Therefore, the third area of concern is motivation. It is hoped that achievement motivation will be developed by introducing tasks designed to maximize interest, to provide success experiences, to provide supportive and corrective feedback from responsive adults, and to gradually increase the child's responsibility for task completion.

The educational program takes place within the context of a structured learning environment. By utilizing a structured learning approach, the emphasis is on educating the teacher to plan and present relevant and organized learning situations. The content of instructional units was presented in small logical steps. The children's progress was evaluated and corresponding program adjustments made as part of an on-going process.

Within the context of this structured environment, we still emphasized flexibility as essential in order to meet the needs of the children and the teacher. Opportunities could be provided for both directed and non-directed instruction. There was greater opportunity for direct child-teacher intervention. In our judgment, the orientation and approach of this project could effectively be applied throughout the preschool years and is an appropriate preschool program.

Logistics

The present groupings and teacher-pupil ratios vary with the age level of the child, but are flexible to allow for individual child needs. Under most circumstances, the infant remained with a teacher on a one-to-one basis up to 12 months at which time another teacher and child were paired with him to encourage the expansion of relationships. At 18 months, two children were assigned to one teacher. At about 24 months, all children of the same age level (about a five month span) were grouped together with enough teachers to afford a 1:2 teacher-child ratio with no group exceeding ten children. During the structured learning periods, the teacher-pupil ratio may be 1:2, 1:3, 1:4 depending upon the age and the ability of the children. Within each age group, behavioral and educational evaluations are made by the teachers, teacher supervisor and curriculum supervisors in bimonthly conferences which may result in decisions to regroup children, provide individual instruction or curriculum changes.

To facilitate learning and teacher effectiveness, a structured program is planned for each age group. The schedule remains constant to aid the child in developing realistic expectations and time orientation. For children under 24 months of age, the teacher varies the schedule in consideration of the child's moods and attention, while teachers of children older than 24 months follow the schedule somewhat more closely, gradually increasing the demands made on the child's attention span. Though a child is never forced to remain in a learning area, the teacher is encouraged to make it exciting for him to do so. Before proceeding with a discussion of each of the specific learning areas, the stimulation schedule of the Milwaukee project is presented.

8:45	Arrival
9:00 - 9:30	Breakfast
9:30 - 10:00	First structured learning period
10:00 - 10:30	Second structured learning period
10:30 - 11:00	Self-directed activities
11:00 - 11:30	Third structured learning period
11:30 - 12:30	Sesame Street
12:30 - 1:00	Lunch
1:00 - 2:00	Nap
2:00 - 2:30	Snack
2:30 - 3:00	Fourth structured learning period
3:00 - 3:30	Fifth structured learning period
3:30 - 4:00	Motor period
4:00	Departure

At present, there are three intact groups. Each of the three staff members for each group teaches one of the morning academic areas. During the course of the morning, the children move in their small instructional groups (2, 3, or 4 peers) from academic area to area. Each period is 30 minutes long with 20 minutes of direct instruction and 10 minutes of indirect instruction when the child is encouraged to use some of the material the teacher presented in his own way. The level of the lesson is varied by the teacher to be appropriate for each small group. The morning structured learning periods consist of language, reading readiness, and arithmetic and problem solving areas.

During fourth and fifth structured learning periods the Peabody Language Development program is used. This involves about half of the children. The other half participates in reading, art, music or self-directed activities.

Goals, Methods and Materials

Each subject area chosen for the program was considered as a vehicle through which we hoped to foster the abilities of input, retention, interpretation, integration and utilization of symbols. The subject areas, used with the children after 24 months of age, were language, reading readiness (or reading), and the combined area of mathematics and problem solving. To a considerable extent the rationale for the choice of these subject areas is obvious. In addition, they also represent the most manageable and easiest to define curricula for very young children. Furthermore, the importance of their mastery extends far beyond the school years.

The area of problem solving is somewhat unique. We included this area to facilitate the flexibility and creativity necessary in spontaneously occurring problem situations. In the following section, the general goals of each curriculum area (language, reading, mathematics/ problem solving) are presented with sample age appropriate activities. We have indicated wherever commercially prepared programs have been utilized.

1) Language:

Language may be divided into receptive and expressive skills. Receptive language includes the ability to attend, discriminate and interpret auditory stimuli. Expressive language involves developing vocabulary, communication skills, obtaining and distributing information, and solving problems.

Activity

Sample Language Activity - 3 year old children

a) The teacher stands in front of the children and stamps her foot. She asks the children to explain what they see her doing.

b) The teacher then makes two or three actions in a row with the children's task being again to explain what they see.

c) Then, two or three tasks are engaged in at the same time by the teacher.

d) The roles are reversed with a child taking the place of the teacher.

Sample Language Activity - 5 year old children

The teacher places a hammer, nails, glue and sandpaper on a table. She explains that she used these four items on the weekend. "What do you think I did with them?"

The children are presented with these verbal problems as a group and, as a group offer possible solutions.

If you took fifteen cents out of your wallet, put on your coat and walked out the front door, where did you go?

You closed the back door, turned off the kitchen light, picked up a baseball bat. What did you do next?

The activity for the three year olds focuses their attention on very concrete conditions and requests them to interpret verbally what they see. In this type of activity the use of verbs is emphasized and temporal words must be used to describe the sequences observed. The sample activity for five year olds is an example of an activity which both requires abstract reasoning and provides opportunity for creative responses. With these types of activities the teachers can focus on the association skills which the children use by asking that all important "why".

The following commercially prepared programs have been utilized:

Peabody Language Development Kit - Level #P
  (American Guidance Service)
Building Pre-Reading Skills - Kit A
  (Ginn and Company)
Sounds and Patterns of Language
  (Holt, Rinehart and Winston)
Language Lotto
  (Appleton-Century-Croft)
Language Master
  (Bell and Howell)

2) Reading:

The reading readiness program focuses on developing comprehension skills necessary for retaining and interpreting material presented both orally and visually. The concept of symbols is introduced early and gradually as is phonics awareness and preparation, and the left-right and top-bottom spatial orientation. Visual discrimination skills are also focused on as a prelude to letter discrimination. A most important aspect of the reading readiness program is experience with books which was begun with children as young as 5 months old.

The formal reading program incorporated the above and focused on symbol recognition (specifically letters of the alphabet); word attack skills (rhyming, identifying initial consonant sounds, utilizing context cues); and developing a small sight vocabulary.

Sample reading activity - 3 year olds

A block, lock, clock and sock are placed before the children and they are asked to point to the object the teacher names.

Sample reading activity - 5 year olds

After a trip to the pumpkin farm to get Halloween paraphernalia, the children illustrate something they did or saw that interested them. Each child dictates to the teacher a story or explanation of his picture. The teacher records the child's explanation. They then reread the story together.

The activity engaged in by the three year olds is an early phonics activity. It not only introduces words that rhyme but it requires that a child hear the initial consonant sound in order to successfully complete the task. Difficulty with this type of skill can be recognized early and remediated if necessary.

The activity engaged in by the five year olds is part of a sequence used in the "language experience" approach to reading. In this type of approach the child eventually writes his own stories and captions aided by some "formal" instruction in writing common words. Through this simple introductory activity the children are learning the important concept that the printed word is just "talk written down", and that the letters and words he has been manipulating or copying do have meaning and are of some use to him.

We have utilized the following commercial programs:

Building Pre-reading Skills, Kits A and B
  (Ginn and Co.)
Frostig Program of Visual Perception
  (Follett Educational Corp.)
Peabody Rebus Program
  (American Guidance Service)

3) Mathematics/Problem Solving:

Very early in the program the children begin to have mathematical experiences with space, shape, size; containing, matching, measuring; as well as experiences with number words and symbols. With this as a foundation they proceed to developing concepts of mathematical relations, sorting, seriation, pictorial representation (graphs), one-to-one correspondence, numerals (1-20), number concepts and simple mathematical operation.

Sample math activity - 4 year olds

The teacher places magnetic hooks on the chalkboard in groups of two with the words "belongs to" printed above a line drawn between each of the sets of two hooks. She places on the table a pile of winter clothing consisting of hats and mittens and a set of pictures of each child in the classroom. She begins by hanging a mitten on the first hook and "reads" the statement "this hat belongs to _______". The children then find the picture of the child that the mitten "belongs to". The activity is continued until each of the articles of clothing is associated with a picture.

The above activity demonstrates the introduction of the concepts of a one-to-one relationship, the concept of the mathematical relationship "belongs to", and presents a pictorial representation (an account of these relationships) to the children.

We have also utilized the following commercially prepared programs or equipment.

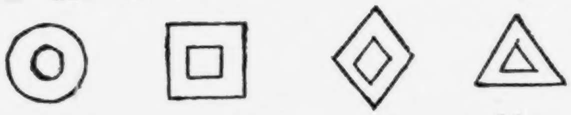
ETA Unit Blocks
  (A. Diagger and Company, Inc.)
Nuffield Mathematics Project
  (John Wiley and Sons)
Cuisinaire Rods

The goals of the problem solving program are to teach the child to gather, organize, apply and communicate information.

Sample problem solving activity - 5 year olds

A set of blocks (consisting of a large and small red circle, green triangle, blue diamond, and yellow square)

are placed on the table in sets of twos as follows.



The children are asked to describe what they see. Then while the children close their eyes, the teacher removes the small red circle and the large green diamond. The children open their eyes and tell what is missing.

This activity helps to develop the children's skill in organizing information, using deductive reasoning and communicating their findings. Mathematical concepts of a set and subsets can also be introduced.

The following commercially prepared equipment has been used:

Inquisitive Games: Discovering How to Learn
(Science Research Associates)
Attributes and Games
(Webster-Division, McGraw-Hill)

Overview

Throughout the past year the project staff has maintained an individualized approach to the learning situation. Within this system, the majority of children in the four and five year old groups recognize and can print upper case and some lower case letters, and are in the process of developing a small sight vocabulary. The Peabody Rebus Program which was begun with the five year old group during the spring of 1970 and with the four year old group during the spring of 1971 is being gradually phased out. The decision was made not to continue the program to its conclusion (the transitioning of the pictorial symbols, "rebuses", to words) because the children were becoming bored with the program. The recent introduction of the "language experience" approach to reading coupled with some phonics training seems to be more successful than the programmed materials.

Modified activities based on the Attributes and Games program have been successfully used with the five year old group and a downward extension of the program is being introduced at the four year old level.

At present we are focusing our attention on preparing the five year old group for school. In September of 1972, 8 of the children in the five year old group will be eligible for first grade. We are providing the children with the experiencing of participating in large groups directed by one teacher. We are also providing them with more time to work individually at their own desks where they are expected to complete a task or a series of tasks whether they be of an academic or non-academic nature. More time is also provided for two or more children to work together independently.

Also all the children old enough to be examined are being seen in local vision, hearing and dentistry clinics to screen for possible difficulties.

Furthermore, a thorough examination of all possible school placements, and a detailed evaluation of each facility, is being prepared.

THE MATERNAL REHABILITATION PROGRAM FOR HIGH RISK MOTHERS

A two phase program was initiated to better prepare the experimental mothers for employment opportunities and to improve their homemaking and child-rearing skills. Through improved employment potential, increased earnings, and self-confidence, it was hoped that positive changes in the home environment would occur. The rehabilitation program consisted of adult education classes to teach the mothers basic academic tools necessary for vocational adaptability, and finally, an occupational training program to teach specific vocational skills.

An effort was made to have all mothers comprising the experimental group participate in the two phases of the program, but while all twenty mothers participated in some phase, for reasons including marital and family problems, motivation, personality conflicts, employment, and subsequent pregnancies, every mother did not always participate.

The job training program utilized two large, private nursing homes in Milwaukee. The choice of private business settings for training was dictated by the strong resistance on the part of the mothers against involvement of community agencies. The choice of the nursing homes as a site for training was made because of the appropriate job skill areas represented in these facilities, the availability of professional staff with some understanding of rehabilitation problems, and the employment opportunities available in nursing homes and other chronic care facilities (Table 6).

During the educational phase of the program, the basic academic skills of reading, writing and arithmetic were emphasized. Because many of the mothers scored low on an occupationally oriented achievement test prior to the program, it was thought that an intensive academic program whose content was the basic skills of reading and arithmetic, would increase the mothers' self-confidence and preparedness for on-the-job training. Classes were conducted four days per week for one month before phase II (on-the-job training at the nursing homes) was initiated. In addition, their curriculum included community oriented social studies, home economics, interpersonal relations and child care.

TABLE 6

Overview of Vocational Training Program for High-Risk Mothers

Vocational Training Area	Time Devoted to Training	Examples of Some of the Tasks in the Area
Laundry	5 weeks	1. Feeding linens into the mangle 2. Folding garments as they are ironed 3. Sorting clothes 4. Operating laundry machinery 5. Mending by hand and machine
Housekeeping	3 1/2 weeks	1. Preparation of cleaning materials cart 2. Learning serial order for room cleaning, e.g, sweeping before mopping, etc. 3. Performing all cleaning tasks with speed and thoroughness
Food Service	9 weeks	1. Stocking and inventorying food items 2. Preparing foods for the cook, e.g., peeling, chopping, cleaning, etc. 3. Cleaning utensils 4. Preparing salads and deserts 5. Operating food preparation equipment, e.g., blender, peeler, etc. 6. Preparing special diet trays
Nursing	9 weeks	1. Helping patients, e.g., feeding, dressing, bathing, shaving and transporting them 2. Taking temperatures and counting pulse 3. Caring for the incontinent patient

When the training program shifted to the nursing home, it became apparent to the supervising staff that the mothers were acquiring a group spirit which in and of itself, was serving to enhance positive attitudes for work and achievement. Those mothers who were having difficulty adjusting to a didactic milieu for various (oftentimes familial) reasons were frequently enjoined in some manner by the other group members into participating. In many ways the result was a therapeutic situation for the group. The defenses with which some of the mothers entered the program were quickly dismantled. For example, one mother, who never in her life had held a job for longer than three weeks, would often verbally attack her teacher and peers during the initial stages of the academic training program. Like other women in the program, she had been reluctant to join not only because of her children at home but because she felt that her inability to read well would preclude ever obtaining a job -- a problem that nothing could rectify. She even acknowledged at a later time that she had convinced herself that she couldn't hold a job because of her academic deficits. She wasn't sure that after so many years away from school, she could learn to read and write better. The mothers gathered around this woman and through long, heated, usually emotional conversations, which many times interrupted classroom instruction, talked over her fears and other problems. Sometimes on weekends they talked over coffee in one of the mother's homes. Finally, she began to realize that she did have the ability to finish the program. She finished near the top of her class and is currently employed at one of the nursing homes as a nursing assistant.

Another mother who came into the program with a belligerent attitude and the intent to sabotage the goals of the instructors, was swept into the serious mood of the other women who were determined to improve themselves. Toward the end of the program, one Saturday evening there was a knock on her door: in came her classmates with a big cake to celebrate both her completion of the program and the remarkable, positive change in her attitude. Almost to a one, they had disliked the way this woman had chided the instructor and disrupted class by whining, arguing, and name-calling. When these devices didn't win the attention she sought, they faded out. Peer pressure more than anything seemed to bring her and other recalcitrants into the spirit of the program. She finished the vocational training and is now employed as a dietary aide on a full time basis.

During phase II, the mothers received 26 weeks (three days per week) of vocational training, most of which was on-the-job training. Many of the women who were doing only moderately well in the academic phase suddenly renewed their interest and enthusiasm in the program when academic skills became applied.

The method devised for training was to pair each mother with an experienced employee. When a mother encountered difficulties that her workmate could not resolve, she was removed from the work situation, given special help and then returned to the work area.

During the vocational training phase, the mothers were trained in four different areas of Health Services: nursing assistant, dietary aide, housekeeping and laundry. Each mother was allowed to progress according to her individual learning rate. Group counseling sessions were held at the end of each day of training. After vocational training was completed, each mother was evaluated by her training site supervisor in each area on the Revised Jewish Vocational Service Employability Rating Scale. Only one mother received a borderline rating. The others were evaluated as being employable.

Not all mothers who completed the vocational training program sought jobs for which they were specifically trained. One woman who was taught skills for becoming a nursing assistant, decided she preferred sewing and found a job as a seamstress. "I want to try something I have never done before," she told her peers. Subsequently, this woman has moved her family into a better home and neighborhood. Perhaps this type of independence of mind and self-assurance was a major objective of the rehabilitation program, and to the extent that some of the participants achieved a measure of this, it seems that the program has realized some of its intended goals. Another major objective was to teach the mothers home economics, so that even if some of the mothers didn't obtain employment after vocational training, they returned to their homes with a better knowledge of household management.

While the occupational habilitation component of the maternal program appears to have been quite successful to date, major problems with respect to adequacy of homemaking skills and care and treatment of children remain to be resolved with a number of experimental families. With many of the mothers now successfully employed, the maternal program is shifting to an increased emphasis on training in general care of family and home, budgeting, nutrition and food preparation, family hygiene and the mother's role in child growth and development.

In order to illustrate the character of within-family problems found among our "high-risk" group, the following anecdotal descriptions are provided. For this purpose, no distinction is made between the control and experimental families with whom we have intervened. Therefore, these descriptions cannot be taken as representative of present conditions prevailing within every family with a retarded mother. Further, the reader is cautioned that these descriptions cannot be taken as representative of the "disadvantaged" population. While it is true that these mothers are members of the "disadvantaged", they differ in that they comprise the relatively small proportion of that group who may be identified as retarded. The adaptive behavior of this group of mothers, as reflected in the extensive histories comprising the "high-risk" population survey is distinctly different from that of their neighbors with whom they share the disadvantaged environment.

Our analysis of the home life of these families attempts to convey the general character of the families. It is, in effect, an anecdotal report designed to supplement the structured interview and test data being obtained as part of the project design. It attempts to provide a picture of the families' environments that cannot be communicated by survey and test statistics, numerical profiles or the other "dehumanizing" embodiments of research studies. Furthermore, the portrayals presented herein will, to some extent, dispel some of the stereotypes that exist concerning low socioeconomic families. After a closer look at the homes, for example, we were ourselves both surprised and shocked. We became aware of the incredible tenacity with which some of the families manage to stick together amid a seemingly relentless onslaught of misfortunes, tumultuous family crises, and more than their share of ill health. There are also, however, a good many families that, though having few resources, still manage to keep a clean home, see that their children get proper food, clothing and education, and in general provide what would be considered a sound home environment in any community.

Once again, we wish to point out that the following is by no means an in-depth study of each family associated with the project, but a general overview which, hopefully will give meaning to our statistics. Although all of the families with whom the project has contact will not be presented, we have characterized over half their number and selected, representatively, those reflecting the range of variety in home environments of both the experimental and control groups. There is of course no way to avoid the subjective, but information has been carefully gathered with the hope that it fairly reflects reality. Names of families or other identifying attributes of the families have been changed for their protection.

Carrie is now 5 years old. Carrie's parents constantly argue. They argue about economic problems mostly, but the arguing usually becomes more personal. Carrie's mother is a swinger. Ask anybody in the neighborhood. Quite often she goes out to night clubs with her girlfriends. Sometimes the house is clean and sometimes Carrie is dressed properly, but when this happens it is due to her father. Since the mother is out a lot, he must assume such responsibilities. Carrie's mother goes out without Carrie's father because he has not proved himself reliable as the bread winner. He, however, feels it isn't due to any fault of his own. He has tried to get a good job, but since he is unskilled, the only jobs he's ever been able to get have been manual labor and back-breaking work in the foundry. The pay is good, when he's employed. But he's not employed a lot because whenever production is slowed down, he and others like him, poorly educated and unskilled, are the first to be fired. Jobs are difficult to find now during the current recession and Carrie's father has worked only two weeks in the past four months. This was a job with a clean-up crew hired by a large construction firm on a two week limited employment basis. At the end of his two weeks, Carrie's father got his paycheck of seventy-two dollars, cashed it and bought his wife a new portable radio. He was in her favor for a week after that. He looked for more work, but he got bored and started drinking. Like always, instead of arguing, Carrie's mother started going out on the town again. Last year Carrie's mother was hospitalized for stomach ulcers. She decided it was because she worried about the family. When she recovered she vowed not to worry so much. This has become quite a convenient excuse. Now Carrie's mother is able to justify going out at night as a necessity because this relieves her worries and reduces her stomach problems. Carrie's father complains to Carrie even though she's only five years old. Her father told her that her mother "lays out all night." Carrie once told her father, "you're dead," an expression she picked up from an argument between her father and mother one evening. That argument raged and kept the entire family up half the night. Carrie's father looks depressed most of the time. Carrie's mother has gone elsewhere for companionship. Frequently she will say she's going over to a girlfriend's house, and then won't return until the next day. Carrie is not an only child; there are five other children in the family. The oldest is sixteen. Carrie's father appears to love her and the other kids, but when he goes out and drinks heavily, the older ones must take care of the younger children until he's sober enough to resume responsibility. This is a pattern which appears frequently; i.e., the relinquishing of parental responsibilities to an older child. This is obviously a less than satisfactory situation since it is not usually a short term arrangement but one which is frequently the case. When Carrie's parents argue, it sometimes gets so intense and violent that things are thrown. The five children, when awakened by the noise, will all huddle together. When they fight, the parents often try to use the children in their battles to disprove one another's allegations. The kids have learned by now to stay out of it, knowing that giving support for one parent will lead a short while later to blows from the other. The morning after such arguments, the school-aged children usually arrive at school late, their eyes red from lack of sleep. The teachers, knowing the family, say nothing.

Bill's parents, although also together, are also incompatible, but in perhaps a less volatile way. Bill's mother works nights. Bill's father works days. When either of his parents are at home, they generally sleep or watch television. Bill has six brothers and sisters. There are also two grandchildren living with Bill's family in the home. Bill's parents don't like noise very much. When any of the kids are disruptive or disturbing while either parent is home, they receive a sound beating. The beating is given with an old razor strap across their bottoms. When the kids are really bad, then they are strapped across their legs and arms; Bill's dad knows that that's what hurts the most because when he was a child, that's where he was hit when he was really bad. Bill's older sister does most of the cooking and cleaning and takes care of the kids. She doesn't go to school. She has her parents' permission to exercise the same punishment if the children get in her way. The sister is of school age but doesn't attend. She doesn't respond if you ask her a question. She just stares. Bill is much like his sister. As a matter of fact, he is sometimes called "the sphinx" because he won't talk. His mother said once, "I told that kid I'd beat him if he doesn't talk." But instead of talking, Bill just looks scared. Like all of the children in the family, he is very slow to answer questions and withdraws from strangers. The older sister has nearly all the responsibility of taking care of Bill and his infant brother, Doug, since the parents are either working or sleeping. Doug used to cry when he needed changing, but soon stopped since no response was forthcoming. The sister was never taught when to change a baby;

consequently, she only did so when the smell got so bad she just had to. There were no diapers for the baby, so she used old rags as diapers. The baby was not fed well or regularly. The sister would give the baby milk only if the mother had bought any. Sometimes there would be none to drink, so the baby was fed Kool Aid instead. The milkman used to deliver milk, but that was during a period when both parents were working and all the bills were paid. When Bill's father was laid off they let the bills go for a few weeks. Eventually the milk company stopped delivering. Now both parents are working again, but they can't get the milk company to come by because their credit is bad. Periodically, Doug breaks out in a rash, like hives, and it lasts for weeks at a time, and then goes away.

When a person walks into Eric's home he can't help but be impressed by two things. There's a big beautiful television, but the rest of the furniture is shabby. The family constantly moves from one home to another and consequently each home is in constant disorganization. Often they move so the mother can live with a different man. Eric's mother is usually on welfare, but she works when she can find a job. This is not very often. For a while, Eric and his older sister and mother lived with Eric's baby sitter. For the most part, Eric is a quiet little boy. His mother is gone quite a bit, so his older sister, who is fifteen, takes care of him most of the time. She seems to be sick a lot and often misses school. Eric had to have a number of stitches in his head when he was very young. A lamp perched precariously on a table fell on him. He was lucky. Eric often looks sickly. Some weeks he looks sicker than other weeks, depending upon how the economic situation of the home is for that particular week. The mother says she is very proud of Eric, and babies him whenever she's at home. People who know her say that it is not so much that Eric's mother is promiscuous, as she knows no other way to provide for her family. Her own mother, in fact, had lived with many men while she was growing up. Eric's mother never knew her real father. One can guess then that it only seems natural to her to live with any man that can provide for her and her two children. When one talks to Eric's mother she gives no impression of having any expectations other than survival. She says she would like her children to finish school, but then again this really is not so critical since school didn't do her any good: it never got her a job, so she isn't so sure her children would benefit from school. Eric's mother is always visiting her family. She visits her sisters, her brothers, or her mother, who all live within a six block radius of her present home. If she's not visiting one of them, they are usually at her house. As children they would do things together, tell each other their secret thoughts, while their mother was out looking for work or with a boy friend. This sibling bond has never been broken and all but one sister, who moved out of the state with her husband, stayed in the same old neighborhood. Not that they wouldn't move out of the inner city if they could, but somehow, this seems a retreat for them all. When they are together they always talk about their respective family problems, unpaid bills, and pretty things they would like to buy.

Sally's mother works five hours every night. Somehow she still manages to keep an immaculately clean home. She's separated from her husband but not divorced. While Sally's mother works, her sister takes care of her and the other four kids in the family. Mostly, Sally is dressed in noticeably bright clean clothes. She seems to be a happy child with a good disposition. Sally's mother keeps telling everybody, neighbors and family alike, that she wants her Sally to go to school so that someday she'll have more than she ever had.

Alec is an only child. His mother is separated. Alec's mother literally lives just for Alec. Alec responds to this by always going up to his mother for a big hug. Sometimes his mother talks to Alec like she would to a brother, even though he's only five. Consequently, Alec is very grown up for his age. When his mother is working, Alec stays with his baby sitter who lives in the apartment above their's. He watches television constantly, and he can tell you almost everything that comes on, whether it's good or bad. Although the mother goes out with friends once in a while, she doesn't leave Alec for very long. She always takes him on vacations with her. Once in awhile she spanks him, but always for a good reason. Alec's mother will often call his teacher about him. She is always concerned for his welfare but she seldom discusses her personal problems. She just lives for Alec.

George lives in an upper flat in the inner city with his mother and two teenage brothers. He has lots of toys and books and the t.v.'s constantly going. Like Alec, George watches a lot of television and can tell you about most of the programs. He has a cowboy outfit with guns and holsters which he usually wears while watching t.v. George is always talking about his two teenage brothers. He is very proud of his brother. George's father does not live in the home. His father does visit from time to time. When his father visits there will usually be a terrific argument between his parents. During some of the arguments, things will be thrown. After George's father leaves, all returns to normal again. George's mother has always been so proud of him. George's mother has a lot of problems with her teenage boys: stealing, truancy, fights in the neighborhood. For that reason, she watches over George very closely. His mother doesn't speak much, doesn't look at strangers when they come into the home from the various agencies, even those that have dealt with the family over the years. George's mother didn't finish high school. But when someone tells her something nice about George, her eyes light up and after a while she warms up and starts talking about how wonderful her George is. George's father has been in and out of institutions since he was an adolescent. He thinks someone is out to kill him, and he's not sure if it's the police or the underworld. Often, when he's left the home for a period, he will call George's mother at 3 in the morning and say he has to see her, but he can't come home because they'll get him for sure. He asks for her to meet him somewhere, it's urgent. The mother says that's silly and tells him to come home because there's no one after him. Although George's mother will plead that he come home, the father will be afraid to and he won't return until his fear has passed. He's supposed to be on a special medication, but he never stays on it unless he's in an institution where they force him to take it. George's grandparents have been trying for years to get him committed for a longer period to a hospital where he can be straightened out, but thus far have been unsuccessful. George's grandparents think their son is dangerous. Sometimes George's mother would sit up weekends until four in the morning waiting for her sons to come home. They're only about 14. It is no wonder that she seems like she's always looking to protect George from whatever made her teenage sons go bad. She's always looking for bigger and better things for her son George.

Linda's mother just had twins, which makes seven kids in the family. Though the father works he makes very little money. They recently have received financial aid to supplement his low earnings. The furniture in the home is old but Linda's mother keeps their house clean. She dresses her Linda well: Linda is always dressed in clean clothes, though usually well-worn. Linda has an allergy that causes her skin to break out. But when this happens, her mother spreads a special salve on the infected area that she got from the doctor. Linda's mother has always looked after her children well.

When you first see Stephen, your impression is that he looks like a depressed little boy. Walking into his home, you are overpowered by the strong smell of urine, everywhere. As an infant, Stephen would go for days, sometimes weeks at a time without being changed. There would be whiskey bottles lining the walls. Stephen's father used to beat his mother often. He wouldn't pay expenses for the home and many times the lights and gas would be turned off. Stephen's mother didn't seem to have interest in anything. When asked a question, she would answer very slowly, or not at all. It often appeared as though she didn't understand fully what was said. Once when Stephen was to be picked up, his mother couldn't find him. He had fallen asleep behind the sofa the night before and was still there. There was little interaction between Stephen and his mother, and even less between him and his father. His mother usually kept him lying all day on a soiled bed in a dark bedroom. Stephen's speech is very slow and very poor: no one talked to Stephen, he just stayed all day on that soiled bed. There were no toys and no lighting. At the age of two, Stephen was placed in a foster home. This turned out to be only slightly "better" than his original home. A second foster home proved better. Understandably, Stephen has never been a healthy boy and recently was hospitalized with convulsions. The origin of Stephen's convulsions is not known.

Teddy's mother is separated from her husband, though Teddy's mother recently gave birth to another baby. This now makes two other children besides Teddy in the home. Teddy's mother doesn't work and receives welfare checks to support her children. She keeps a fairly clean home and the family has recently moved into a nicer neighborhood where the mother is living with a new man. Teddy also never talks to adults. His mother has to threaten to whip him with a strap to get him to talk. On the other hand, he relates well to kids in the neighborhood -- then he laughs a lot and talks -- but with adults he remains silent.

In one of the poorest sections of the inner city lives Jerry with his unmarried mother and five brothers and sisters. His mother is best described as a swinger. A visit to her home always finds young men around the house. Since she quit work, the home looks a little better than it has. Jerry's mother spends a lot of money on herself. She feeds her kids snacks like potato chips and cereals; she never learned about nutrition and balanced foods, and seems to be unaware of the importance of such staples as milk and vegetables. Her sister gets disgusted with Jerry's mother for not taking better care of her kids, and has often come over with bags of groceries when welfare money has long been spent on other things. When Jerry comes to the center, he frequently will say he has a "new daddy" living with his mother.

Jeffrey's mother is a very conscientious woman, and sees to it that Jeffrey is dressed properly. She keeps a clean home and takes good care of Jeffrey's father, who is not well. Once Jeffrey's father was treated for tuberculosis and since then has had a number of minor illnesses. Jeffrey and the other siblings have had recurring bouts with ringworm and impetigo.

Since both of Cindy's parents are currently working, the grandmother takes care of the kids during the day. The grandmother prepares most of the meals and tries to keep the house in order. Each day, before she goes to work, Cindy's mother puts the clothes out for the four children in the family. When they get up, they're required to dress themselves. Both parents appear affectionate toward Cindy. The father and mother spend much time with the children during the evening. The children are allowed to go outside but have to play in the yard. Even together the parents don't have a substantial income. The father has been in the hospital a good deal; and only recently got out. The mother works hard to supplement the family income and in addition to both working, the family receives family assistance. Still, they barely make ends meet. This is partly due to the father's doctor bills. He has a chronic ailment and it has necessitated periodic treatment.

Julie's mother sees to it that Julie goes out of the house looking like a little swinger. Julie snaps her fingers rhythmically and at five can do most all the current dances. The parents are considered swingers, go out dancing often, and Julie can tell you what dance is in and what dance is out. They often move and the phone number is always being changed. New neighborhoods find Julie a nasty child. She dances and sings things like "My daddy's got a rifle, my daddy's got a gun, burn, baby, burn!"

Gwendolyn's home is one of the most chaotic. On any given day, a visit to the home finds a mess: there are clothes strewn on the floor in the living room, kitchen, everywhere. Presently, Gwendolyn's grandmother is taking care of her, her four brothers and sisters, plus ten other grandchildren. All told, this makes 15 children the grandmother cares for. The grandmother tries to do the best she can. There are least five small ones that don't go to school. When home, the older children are given much of the responsibility of feeding the younger children during mealtimes. Gwendolyn and her brothers and sisters are living in her grandmother's two story frame home. Shortly after they moved, someone broke into their own home and stole their clothes and other valuables. Now they have to wear the other children's clothes. Sometimes the grandmother loses her temper and straps Gwendolyn across the legs for being naughty. Once Gwendolyn was strapped for not finding her shoes in time to leave for a trip. The strapping left welts on her legs which lasted for days before going away.

Nancy lives with her parents and five brothers and sisters. Her father used to work in a factory until he had an accident and lost his fingers. Doctors tried to graft them on but they got infected and he's had problems with them since. Drinking is a problem with him. He had a really bad spell after the accident. Nancy's parents fight often. Once she saw her father pick her mother up and throw her across the room. When the mother got away, she went to a neighbor's house to call the police. The police came and took Nancy's father to jail. Nancy didn't seem too unhappy about the incident as the next day she talked about it in a laughing way to neighborhood children. The father has had a good deal of difficulty adjusting since the accident. Nancy's mother was finding it difficult living with him.

Anita has a father who disciplines his children in strange ways. Once a social worker was visiting the home and the father had the children lined up against the wall in military fashion. The visitor, who knew Anita, said hi, but Anita said nothing. The children weren't allowed to move or talk. Even when good, no one is allowed to talk very loudly in the home. When the father's not present, the mother is more open and is kind to the children and the atmosphere is more relaxed. Sometimes Anita's mother can't take the father's strictness and she argues with him. Once, after a fight which ended in blows, she had to call the police who came and took Anita's father to jail for the night. He had been drinking heavily with a friend from work. As a child, Anita's father was placed in one foster home after another. He knew his parents and wanted very much to live with them as a family, but they were separated and each was unable to take care of their four children for separate reasons: the mother soon after the separation, had a nervous breakdown and had to be hospitalized for a number of years; the father left for the West and stayed for a year looking for work, but when nothing substantial materialized, he returned north and lived with his brother's family. He couldn't get adjusted and didn't feel he was able to support his children properly, though he wanted to and often told them when he visited that when he got back on his feet, which should be soon, he was going to get a house and they would all live in it together. Unable to find work, Anita's grandfather attempted to rob a liquor store, was caught, and was sent to prison. Anita's father is bitter about his childhood. He never had a real father to play ball with, take him on picnics, or to a football game. There was nothing but chaos in his life. When Anita's father married, he spoke to his wife often about how his children would be raised to be well-disciplined; there would be more order in his children's lives than there was in his own.

Matthew's mother is a pretty young woman, very shy, who doesn't talk much. There never was a father in the home. Matthew has an older brother and sister approaching adolescence. When Matthew was an infant, the house was kept up well, but there were few books or toys in the home. Recently the mother has made a point of buying books and toys for Matthew to play with. She babies Matthew, always washing him or changing his clothes a number of times each day. A neighbor asked Matthew why he still talks baby talk and Matthew said, "My mommy says I'm little and my mommy says I'm a baby." Whatever Matthew wants, Matthew gets. His mother takes him to the grocery store and if Matthew says he wants this or that, his mother gets it for him. She buys him new shoes once every two or three months. Matthew's mother goes out on the town often, to rock concerts and dances. Matthew is taken care of by his aunt when his mother is away. Matthew's mother is very proud of the fact that Matthew can now identify certain words. While the other kids are playing, Matthew is lying on the floor looking at his books or listening to music. He just loves "Nutcracker Suite." He watches Sesame Street every day. Matthew doesn't have a father but he doesn't seem concerned or sad about it. When he is told a story about a daddy, Matthew doesn't get upset or say anything.

Patty has seven brothers and sisters. They moved north about when Patty was born, but now have moved back to the south where her family originally came from. From the time she was an infant, Patty always had toys and books. Her parents were always proud of her seeming precocity. Her father never did too well up north. He worked in a plant and got hurt. Afterwards, with the money he received for his injury, he moved his family back down south where he's since built a new home and is doing much better. When the family moved south, Patty stayed in Milwaukee to attend school. Her father once came up to see her and was proud to learn she was doing well. When the family lived in Milwaukee, they gave their children as many material things as they could afford. When Patty came to school in the winter, she would have two pairs of socks on, tights and pants, undershirt -- double things, because her mother didn't want her to get cold. Often, Patty's teacher would be talking to her parents and they would say that Patty seems so much smarter than her brothers and sisters were when they were Patty's age.

Laura lives in a very messy home. Even when she was smaller she was dressed poorly. Once a social worker discovered a diaper pin stuck through her skin. Laura didn't cry. It almost seemed as though she were used to it. The mother appears to love Laura because she's always hugging her. The father's a jack of all trades. He's known to be able to fix about anything. Both parents talk about Laura to each other and are concerned about her. They never learned, however, how to properly care for a baby. When Laura's mother is at work, the older teenage sisters take care of Laura. Usually Laura's mother cooks for the family, but since she just changed jobs and now works in the evenings, she usually cooks supper before she goes to work and Laura's father heats it up and serves it to the family. The older girls take turns cleaning things up.

Leroy's mother spanks him because he wets his pants. She thinks a good spanking will stop his wetting, but so far it hasn't helped. Leroy's mother is pregnant now and is expected to have her fifth child in a few weeks. She's going through a stressful period with this pregnancy and often seems to take out her discomfort on Leroy.

For his five years of age, Neil is already picking up the temper of his neighborhood. He drew a picture one day and said it was a slingshot to shoot windows. There are three other children besides Neil, aged ten, seven, and six. His father left the home and his mother is not considered very reliable, so welfare hired a woman to come in to do the cooking and cleaning and this woman stays most of the day. The mother has very little to do with the children and goes out quite a bit. The woman from welfare, however, treats the children well. Neil's mother has been taken to court a number of times about the children. Though it appears she loves the children, she's not capable of managing them. The home has broken down furniture, peeling paint on the walls, and poor lighting. Many of the windows are patched with plastic, and there are holes in the patches. There's always traffic in Neil's home, always company. His mother frequently has parties and likes many male friends. Most mornings there are teenage boys in the home who appear to be of school age.

Though only certain characteristics of each home environment were included in this overview of the families associated with the Milwaukee project, neither negative or positive aspects of any one family are mutually exclusive of the others. Yet each family situation is distinct and generalizations concerning all of them would be superficial and unfair unless made only with broad societal trends in mind which affect the entire culturally unique community. Certainly many of the families have not emphasized education as a prerequisite for raising standards of living, and from this a spiraling effect has embalmed ensuing generations in a mold of limited employment opportunity; large, disorganized family structures; sickness and frustration. There have been exceptions to the above, testimonies of the resilience of some families who through perseverance, managed to overcome environmental obstacles which often included racial prejudice and fewer educational opportunities to achieve a standard of living commensurate with human dignity.

For those families caught in a desperate life struggle, it is the children who most always attract public sentiment:

the infant found with a pin stuck through her skin, already seemingly insensitive to neglect; the child recanting hateful slogans at the age of five; the little girl whose father the night before had bodily thrown her mother across a room in a fit of violence, retelling the tale to neighborhood friends, laughing at what will continue to be a humorous event, her parents beating up on each other. What effect these early experiences have on the development of such children cannot be disregarded and is as much a part of this study as the statistics which remain to be presented.

IV

INTELLECTUAL DEVELOPMENT
PRELIMINARY RESULTS

Assessment of the development of the experimental and control infants includes measures of physical maturation; language development; standardized and experimental measures of developmental schedules of infant adaptive behavior; standardized tests of general intelligence; experimental, manipulatory tasks such as sorting tasks, discrimination learning tasks, problem-solving tasks, concept-oddity tasks; experimental non-manipulatory tasks such as auditory discrimination, verbal concept appreciation and object recognition; and finally, measures of motivation and social behavior. In the first twenty-four months of life, the measurement schedule was largely restricted to general developmental scales and emerging vocalization and language. Beginning at 24 months increasing emphasis has been given to experimental, direct measures of learning and performance.

Both experimental and control infants are on an identical measurement schedule. Infants are scheduled for assessment sessions every three weeks. The particular measures administered at a given session depend upon the predetermined schedule of measures for that age level. The advantages of the procedure we are following is in terms of age comparability. The disadvantage is that we muct wait for all or most infants to move through a particular age level before the n's are of sufficient size to permit evaluation. As a consequence, we have accumulated considerable data at the oldest age levels which may not yet be reported.

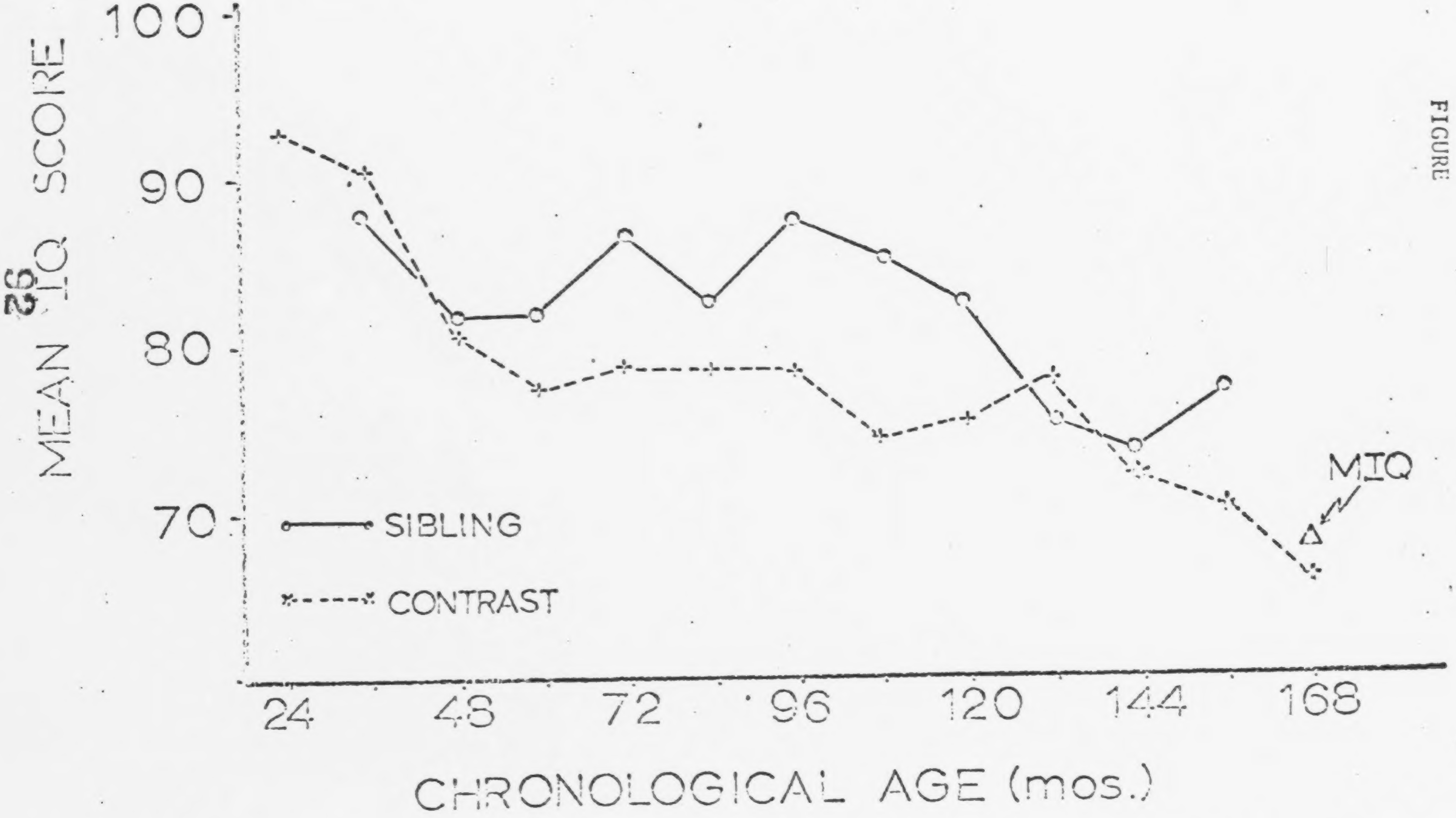
A particular test or task is administered to both experimental and control infants by the same person; the testers are not involved in any component of the infant stimulation or maternal program.

Intellectual Development of a Contrast Group

As stated earlier, the selection procedure based on maternal intelligence was designed to ensure, despite relatively small samples, inclusion of a sufficient number of children who would demonstrate retardation in intellectual development to permit generalization. As a way of illustrating expected intellectual development for our control group, Figure 3 indicates mean Cattell and Binet IQ scores for a group of children of mothers with (WAIS) IQs below 75 from 24 months to age 14 and greater. These data, taken from the "high-risk" population survey described previously, are comprised of children of mothers with (WAIS) IQ less than 75. As seen in Figure 3 , there is a decline in mean IQ from 92.5 at 24 months to 66.4 for children of 14 years or greater. This latter figure rather remarkably approximates the mean maternal IQ of 68, attesting to the validity of the oft-repeated statement that "the mother's IQ is a better predictor of a child's IQ at 18 than is the child's own IQ at age two." It can be noted that the mean IQ at 24 and 36 months is well within the

FIGURE

SIBLING AND CONTRAST GROUP IQ SCORES



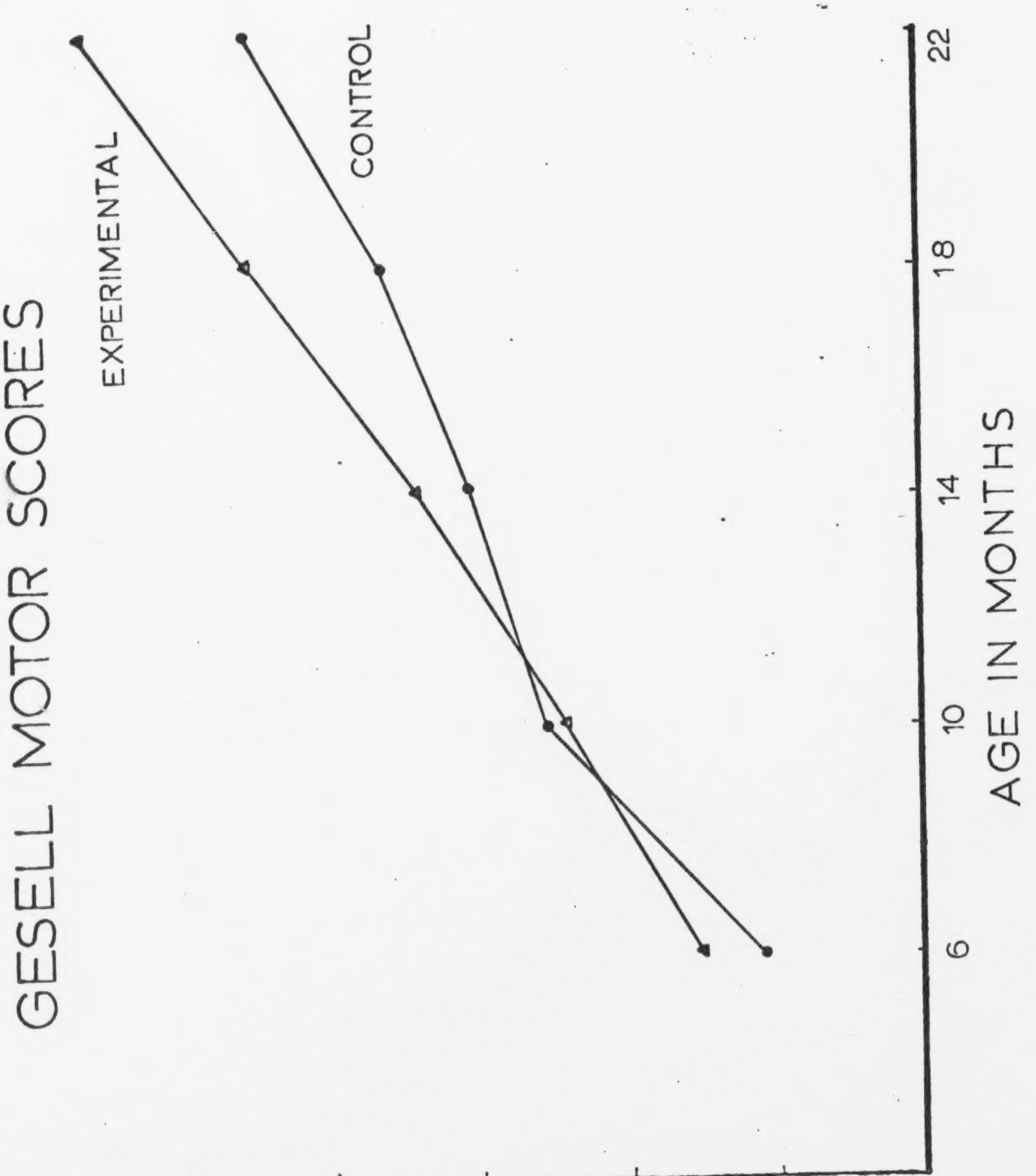

GESELL MOTOR SCORES
EXPERIMENTAL
CONTROL
MEAN SCORE IN MONTHS
30
25
20
15
10
5
AGE IN MONTHS
6
10
14
18
22

FIGURE 4

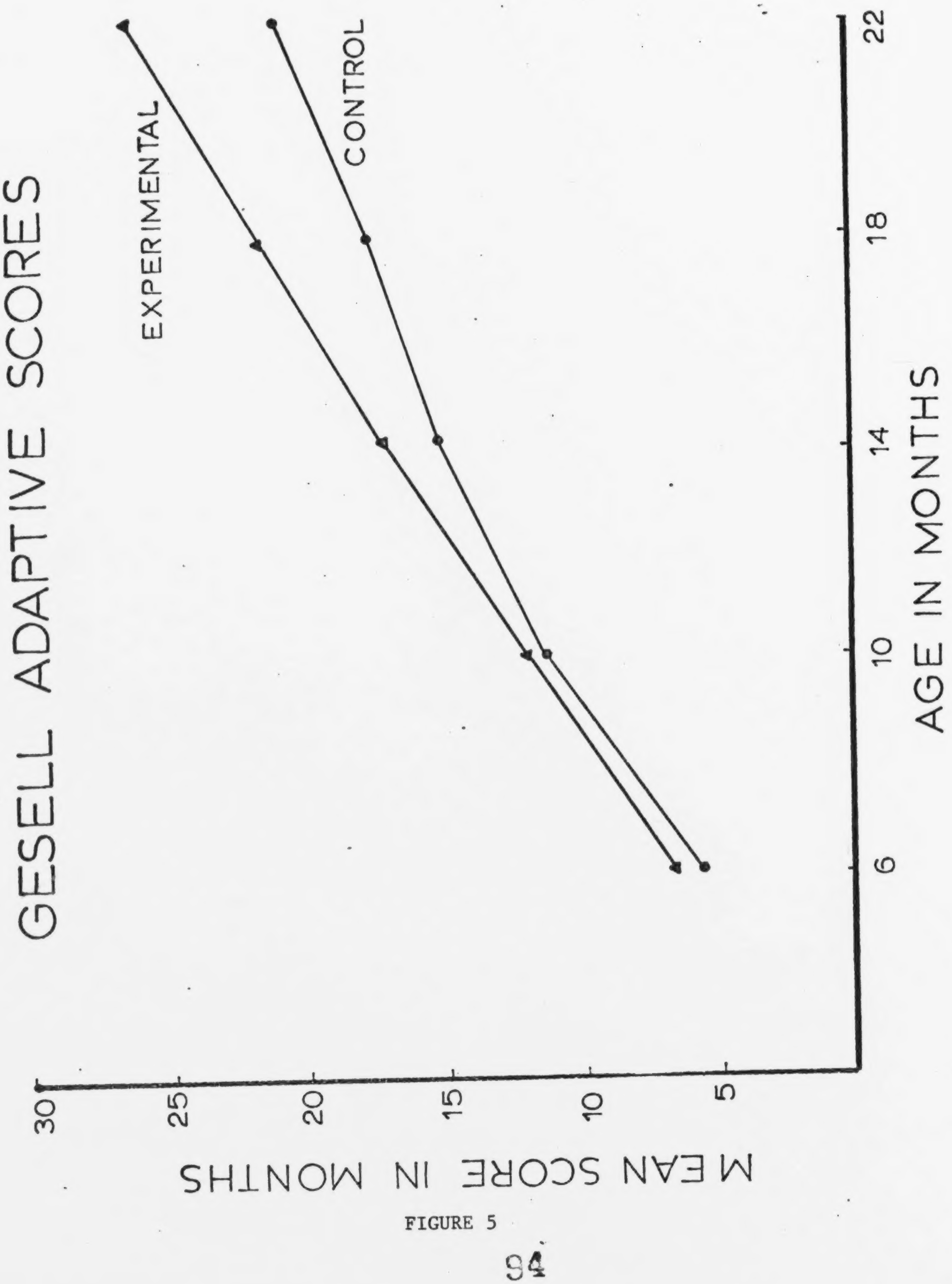

GESELL ADAPTIVE SCORES
EXPERIMENTAL
CONTROL
MEAN SCORE IN MONTHS
30
25
20
15
10
5
AGE IN MONTHS
6
10
14
18
22

FIGURE 5

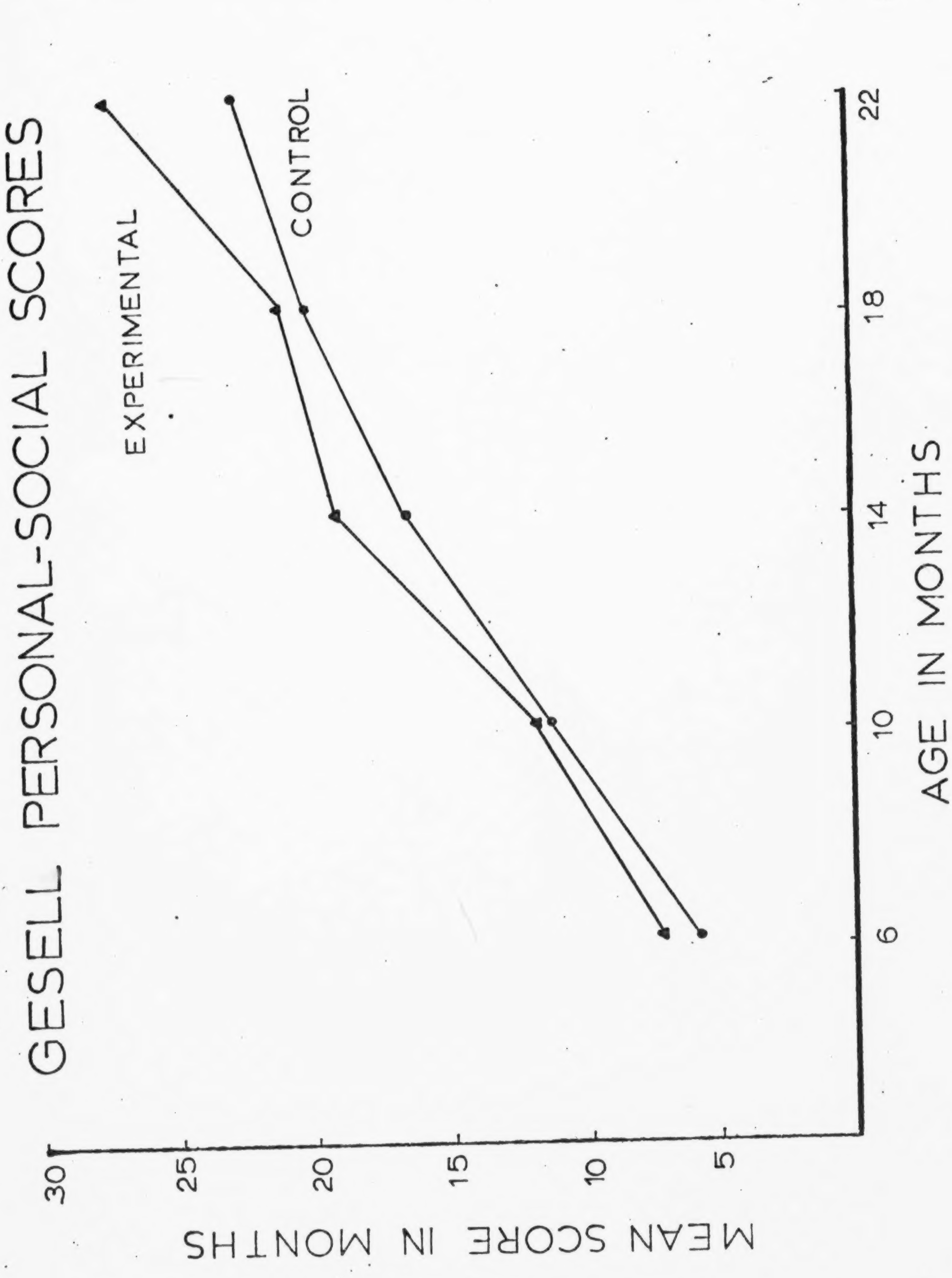

GESELL PERSONAL-SOCIAL SCORES
EXPERIMENTAL
CONTROL
MEAN SCORE IN MONTHS
30
25
20
15
10
5
AGE IN MONTHS
6
10
14
18
22

FIGURE 6

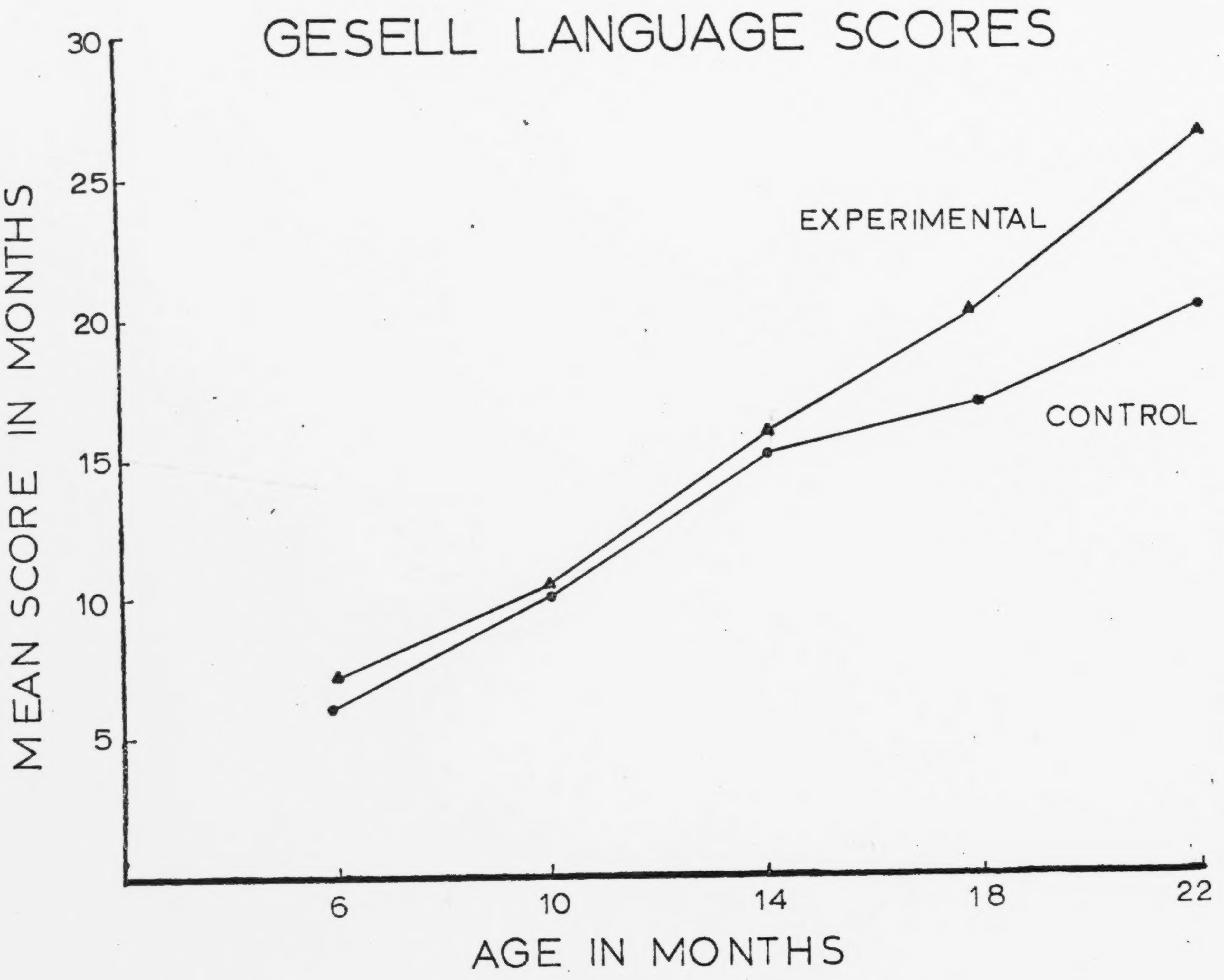

GESELL LANGUAGE SCORES
MEAN SCORE IN MONTHS
30
25
20
15
10
5
AGE IN MONTHS
6
10
14
18
22
EXPERIMENTAL
CONTROL

FIGURE 7

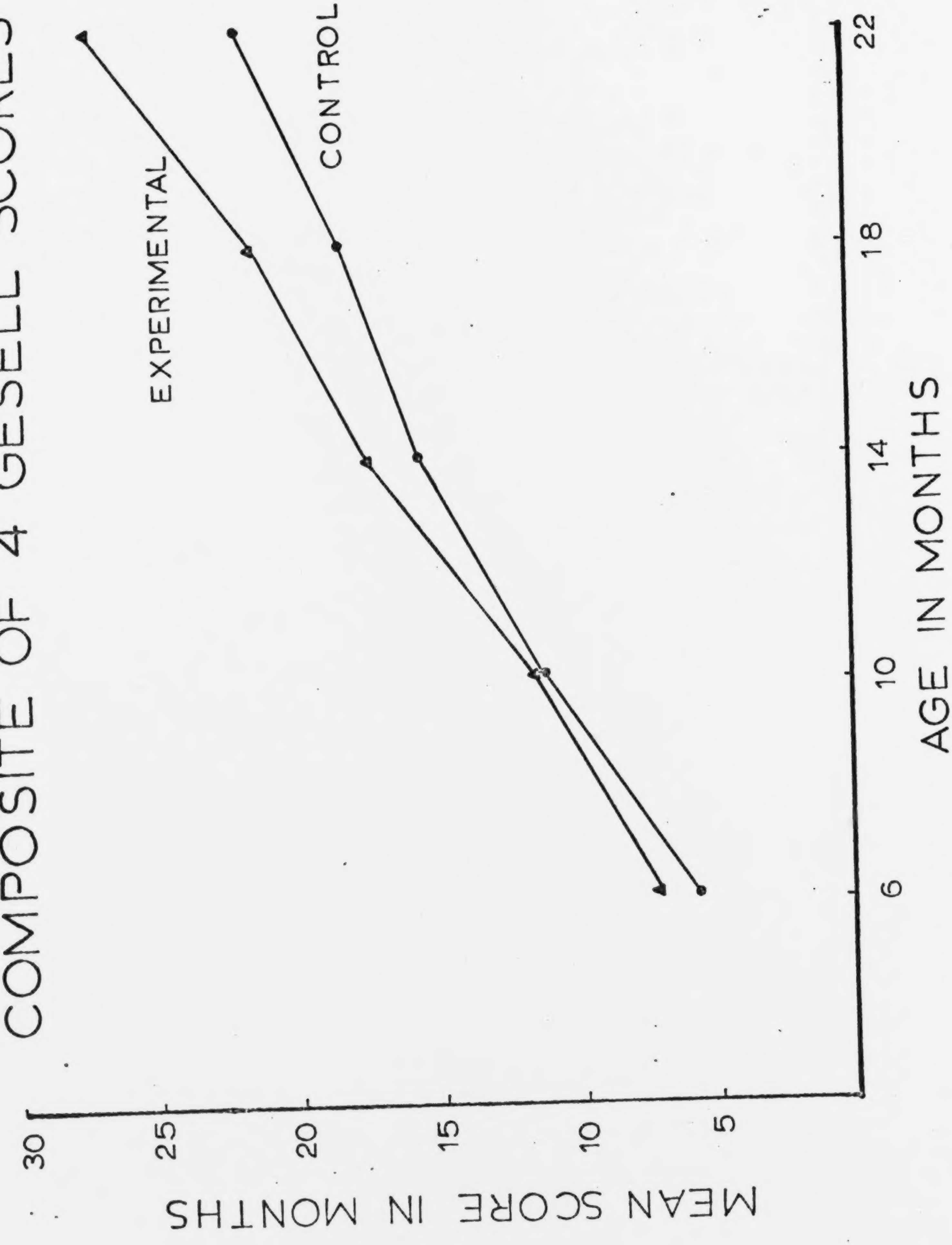

COMPOSITE OF 4 GESELL SCORES
EXPERIMENTAL
CONTROL
MEAN SCORE IN MONTHS
30
25
20
15
10
5
6
10
14
18
22
AGE IN MONTHS

FIGURE 8

average range, and that the major decline occurs between 36 and 60 months. As a consequence of these data, we did not hypothesize any retardation in measured intelligence in the "high-risk" control group, nor any major difference as compared with the experimental group, prior to the age of three.

Intellectual Development to Age Twenty-Two Months

The Gesell Developmental Schedule was administered to experimental and control infants at the ages of 6, 10, 14, 18 and 22 months. These data are presented in Table 7 and Figures 4, 5, 6, 7 and 8.

Table 7

Mean Gesell Developmental Schedule Scores

	6	10	14	18	22 months
Experimental					
Motor	7.4	12.0	17.0	22.5	28.0
Adaptive	6.7	11.9	17.0	21.5	26.2
Language	7.2	10.4	15.8	19.9	26.2
P-Social	7.2	11.8	18.9	20.9	27.3
Control					
Motor	5.4	12.6	15.2	18.1	22.6
Adaptive	5.7	11.2	15.0	17.5	20.8
Language	6.1	10.0	14.9	16.7	20.1
P-Social	5.9	11.3	16.4	20.1	22.7

The data are plotted in terms of the scale developmental age norms for each age level tested. It can be seen that on all four Gesell scales (motor, adaptive, personal-social and language), the performance of both groups appears reasonably comparable at 6, 10, and 14 months.

At 18 months, however, the control group falls 3-4 months below the experimental group on three of the four Gesell scales, although still performing at or close to Gesell norms. At 22 months, however, the experimental group scores from 4.6 to 6.1 months in advance of the control group with the controls falling below Gesell norms on the Adaptive (1.2 months) and Language (1.9 months) scales. These data are presented in Table 8 . The calculation of a deviation score facilitates comparison of the growth discrepancy in months from the Gesell norm and between groups. These data have been illustrated in Figures 9, 10, 11, 12 and 13.

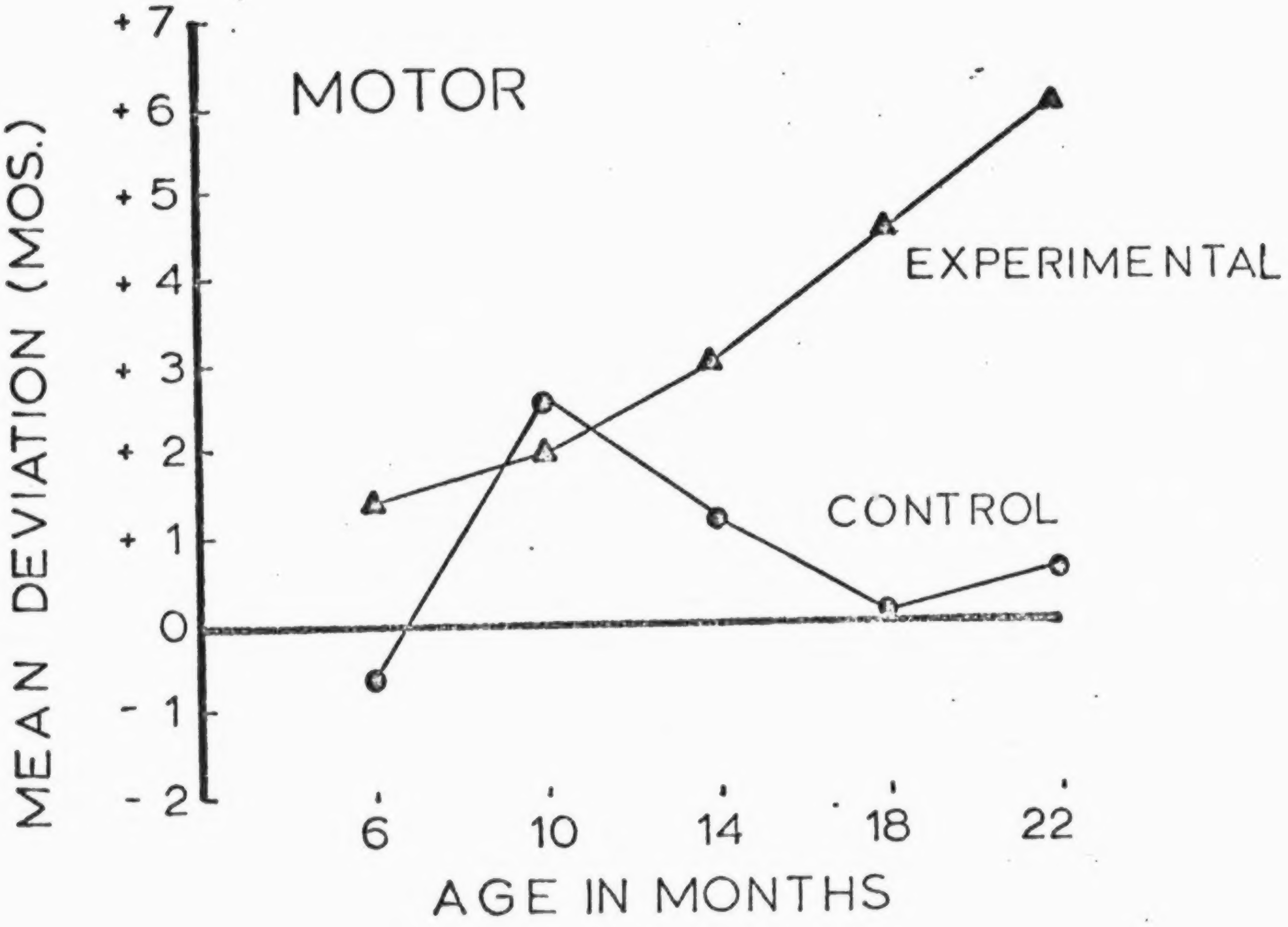


FIGURE 9

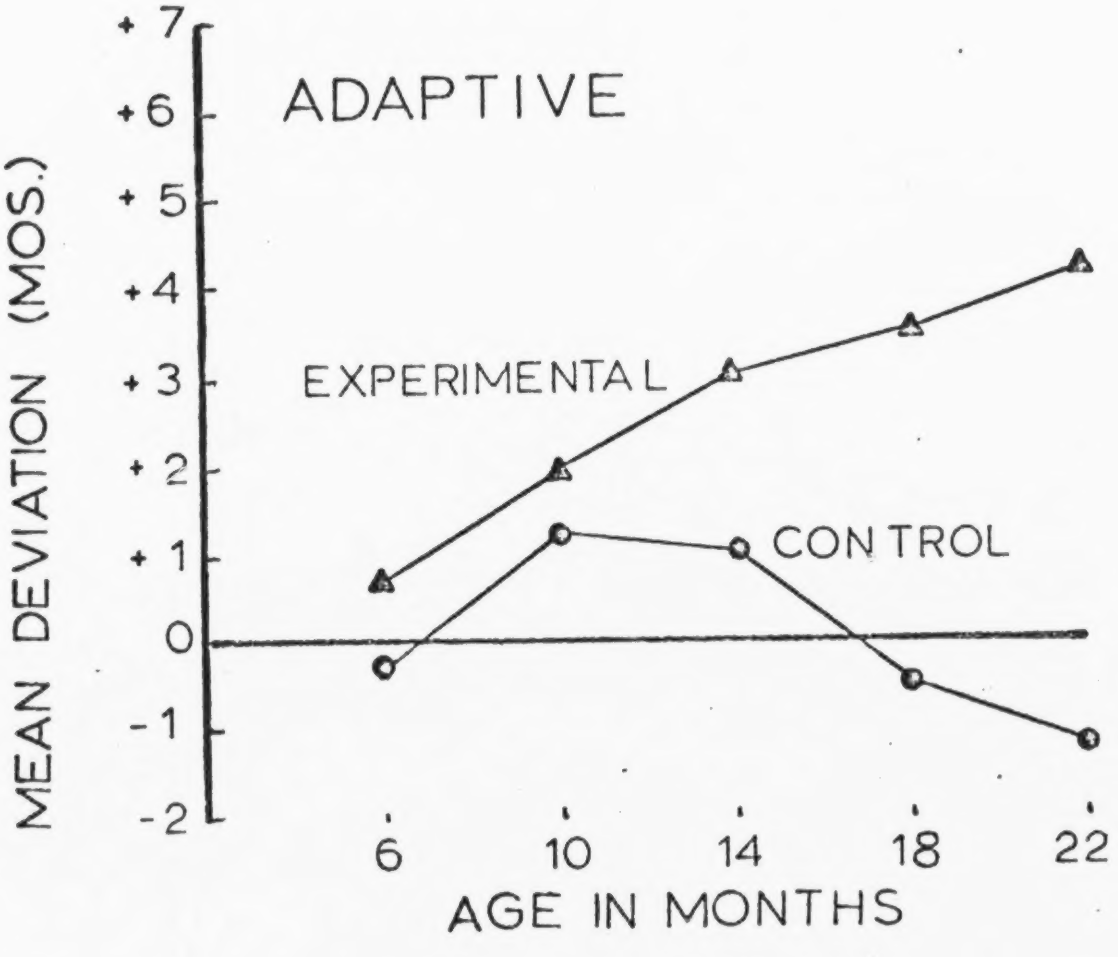


FIGURE 10

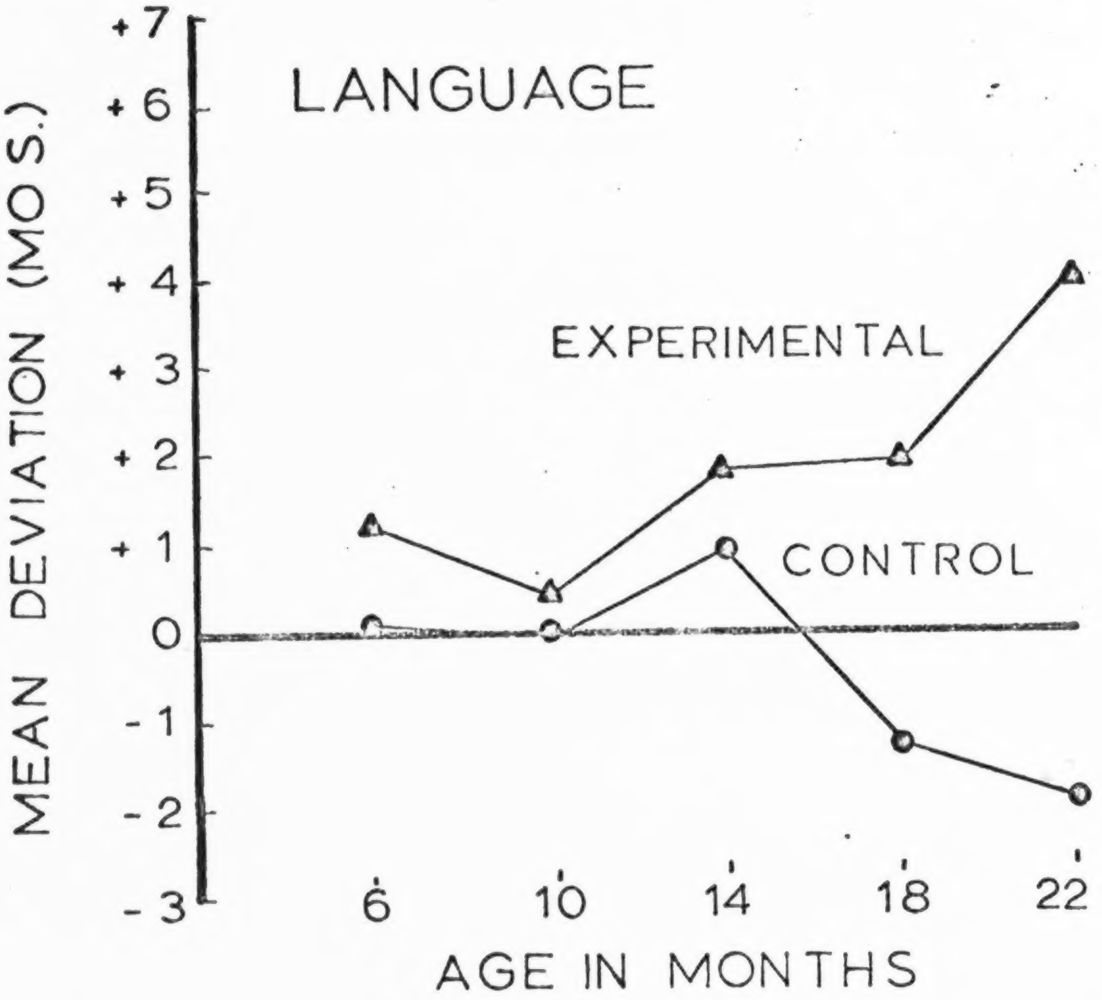


FIGURE 11

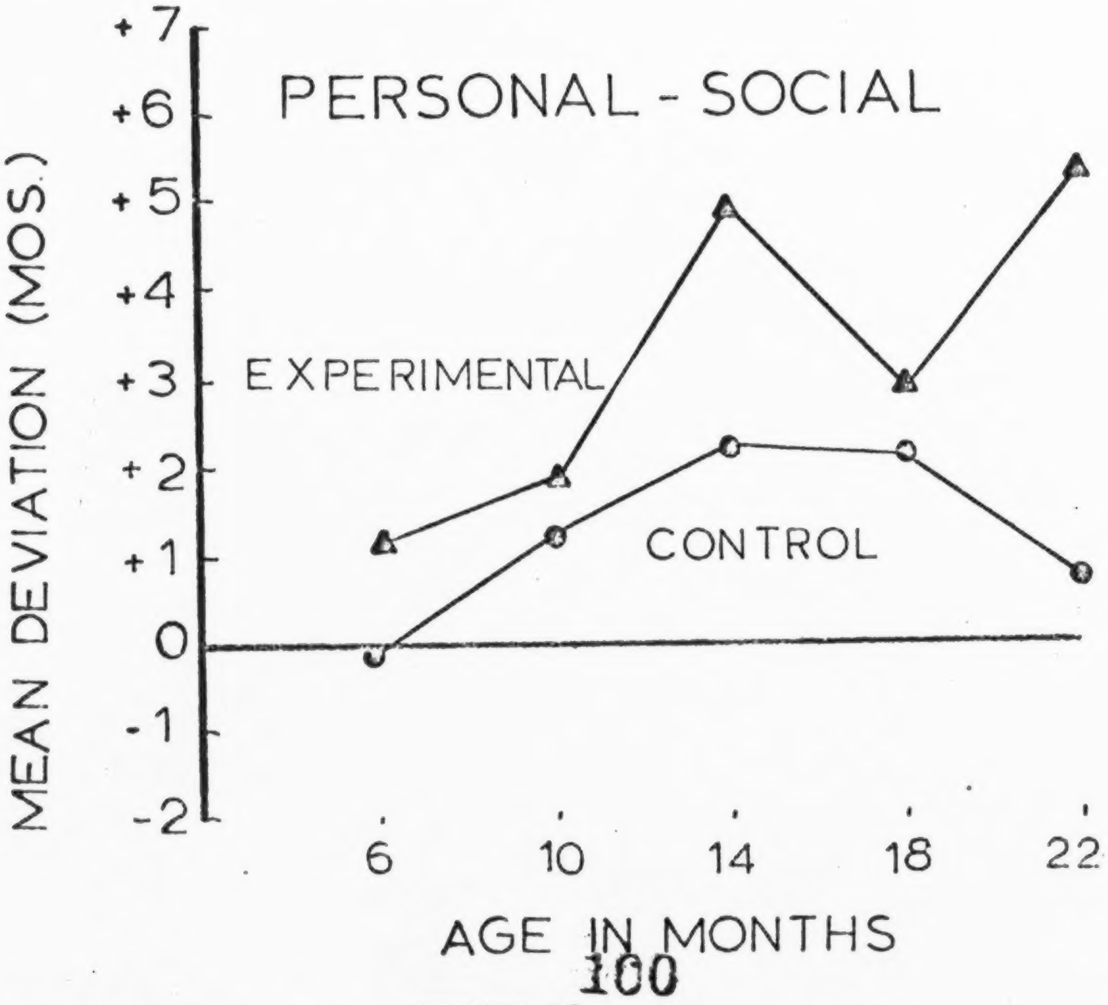


FIGURE 12

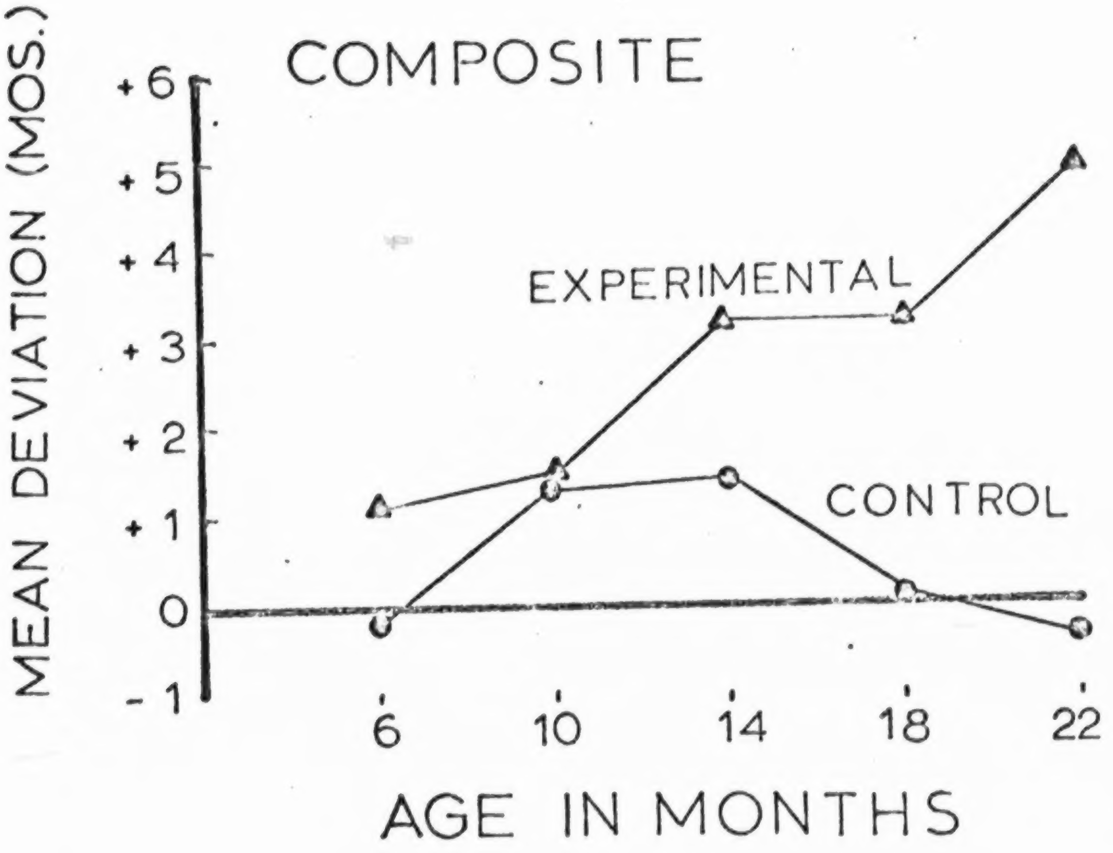

COMPOSITE
MEAN DEVIATION (MOS.)
+6
+5
+4
+3
+2
+1
0
-1
EXPERIMENTAL
CONTROL
6
10
14
18
22
AGE IN MONTHS

FIGURE 13

Table 8

Mean Developmental Deviation Scores in Months from Average Growth Line

	Deviations from Gesell Developmental Schedule				
	6	10	14	18	22 months
Experimental					
Motor	+1.4	+2.0	+3.0	+4.5	+6.0
Adaptive	+ .7	+1.9	+3.0	+3.5	+4.2
Language	+1.2	+ .4	+1.8	+1.9	+4.2
P-Social	+1.2	+1.8	+4.9	+2.9	+5.3
Control					
Motor	- .6	+2.6	+1.2	+ .1	+ .6
Adaptive	- .3	+1.2	+1.0	- .5	-1.2
Language	+ .1	0	+ .9	-1.3	-1.9
P-Social	- .1	+1.3	+2.4	+2.1	+ .7

To summarize, Gesell data is roughly comparable for both groups to 14 months with performance on all scales slightly in advance of test norms. At 22 months, performance of the experimental group is clearly accelerated while the control group performs at or slightly below norms for the four scales.

Measured Intelligence to 54 Months

The Cattell test, extending into the Binet, has been scheduled at three month intervals beginning at CA 25 months, and at six month intervals from CA 48 months on. The WPPSI was administered at CA 51 months. Figure 14 presents IQ data using Gesell scores from 12-21 months, Cattell and Binet's from 24-48 and at 54 months, and WPPSI scores at 51 months. It should be noted that because of the age range the mean IQ for the experimental group is based on the eleven subjects who had reached that age level at the time of this report. For the same reason, too few control subjects have reached the 54 month level to justify computation of a mean. The contrast group in Figure 14 represents the performance of offspring of sub 75 IQ mothers taken from the population survey data referred to in the Introduction section. It is included here simply to indicate the trend of declining IQ with increasing age anticipated for our actual control group. Figure 3 plots IQ data for sixty-eight older siblings of experimental and control families in comparison with the contrast group. Considering the rather small number at various ages, the developmental pattern for these older siblings seems to conform reasonably well to expectations based on the contrast group.

The mean IQ for the experimental group based on means at each three month interval from 24-54 months is 122.6. The greatest deviation from this average is -5.1 IQ points based on the WPPSI mean IQ of 117.5 at 51 months. For the control group, mean IQ for all testings is 95.2 with the largest deviation from that mean being -3.8 IQ points, again occurring on the WPPSI testing at 51 months. The discrepancy between experimental and control group performance at each three month test interval varies from a minimum of 24 IQ points at 27 months to a maximum of 30.1 IQ points at 42 months.

Perhaps more remarkable than the mean for the experimental group is their homogomeity: for the 11 Ss who have reached and been tested at 54 months on the Binet, the lowest IQ obtained is 107; for the 14 experimental Ss who have reached and been tested at 51 months, the lowest WPPSI IQ obtained is also 107. By contrast, the range in performance is far greater for the control group: for the 11 Ss who have been tested at 51 months, three Ss obtained WPPSI IQs over 100 while five Ss scored in the 70's and 80's.

It should be noted that only five control subjects have tested above IQ 100 at and beyond CA 30 months. Of these, three are represented among the 11 who have been tested at CA 51 months, and four are represented among the 13 control Ss who have reached 48 months. This suggests the possibility that the mean IQs for Control group at 48 and 51 months may be reduced somewhat as the numbers at these age levels increase. Eliminating the 3 of 11 control Ss testing above 100 at 51 months would reduce the present mean IQ Of 91.4 to 85.7 for that group.

In summary, the performance to date on standardized tests of measured intelligence indicate a remarkable acceleration of intellectual development on the part of experimental subjects who have been exposed to the infant stimulation program. Further, their performance is quite homogeneous as contrasted with that of the control group where only about one-fourth of the Ss test at or above test norms with the remainder trending toward subaverage performance. However, our awareness of the numerous pitfalls and hazards of infant measurement leads us to extreme caution in interpretation of present data. Our experimental infants have obviously been trained in skills sampled by the tests while the repeated measurements have made both groups test-wise. The experimental group has been provided with intensive training to which no comparable group of infants has ever been exposed, to the best of our knowledge. Have we, thereby, simply given them an opportunity to learn and practice certain intellectual skills at an earlier age than is generally true? And if so, will their apparent present acceleration in development diminish as they grow older? Nonetheless, the present standardized test data, when considered along with performance on learning tasks and language tests (presented in following sections) indicates an unquestionably, distinctly superior present level of cognitive development on the part of the experimental group.

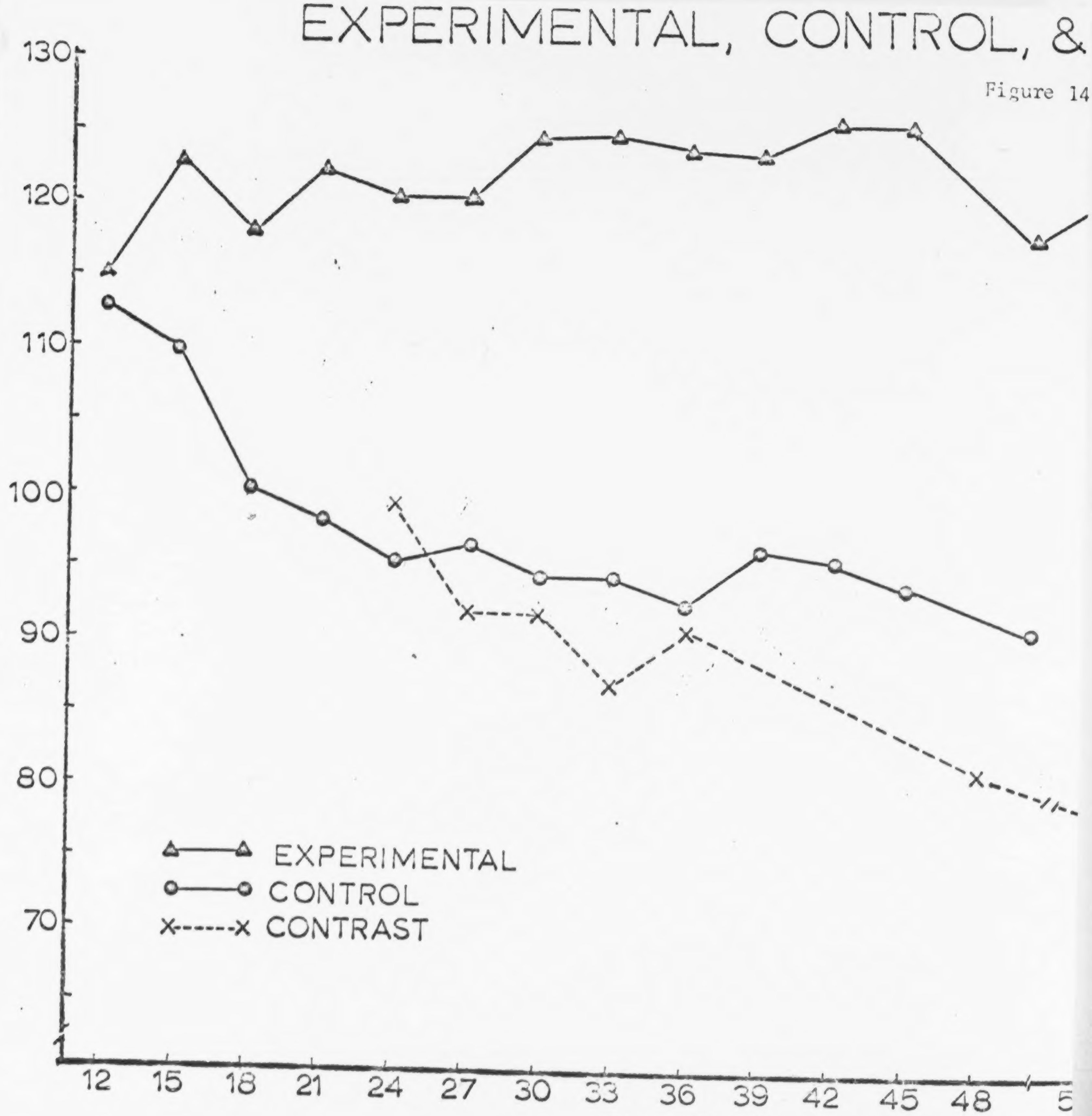
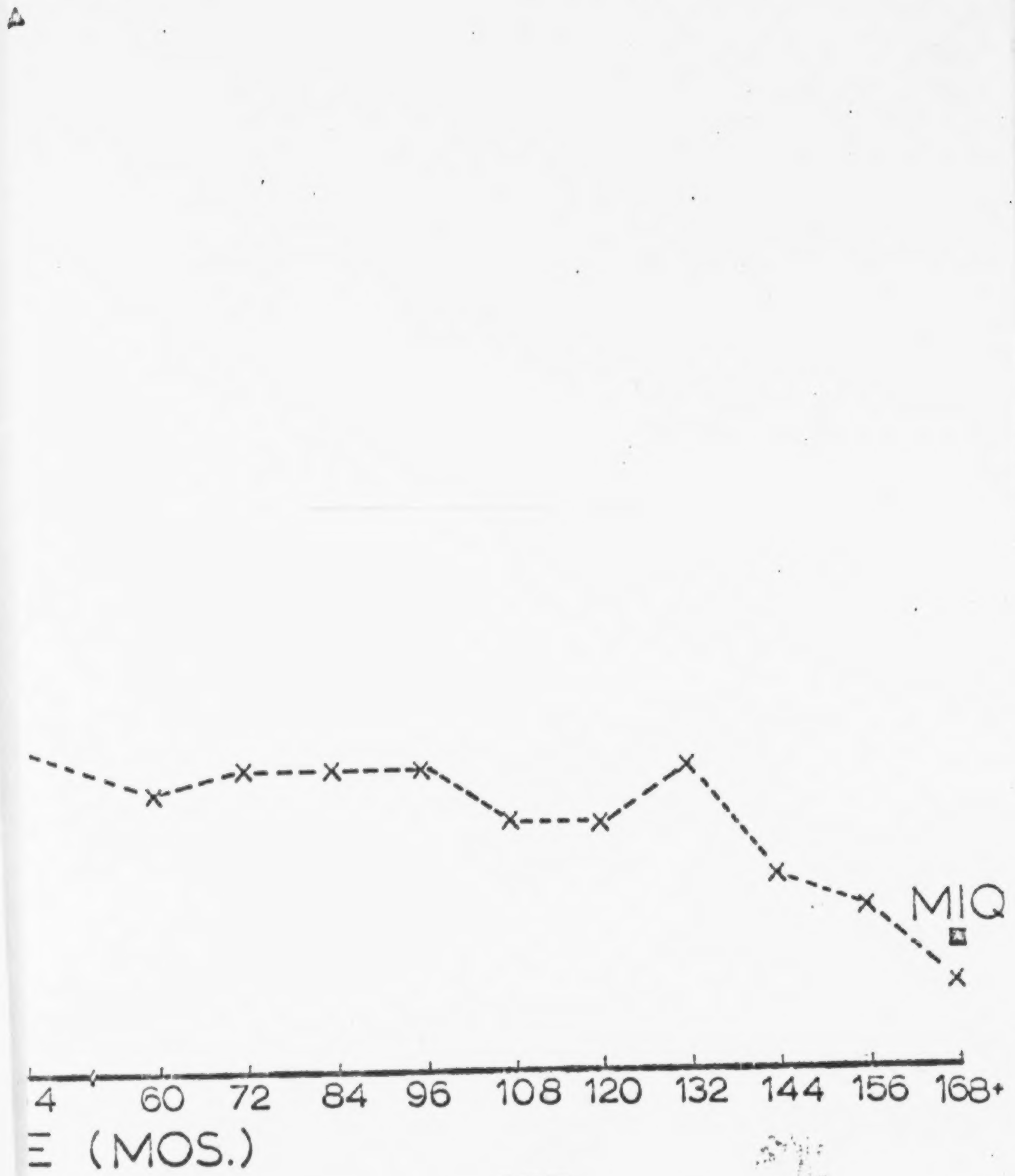

EXPERIMENTAL, CONTROL, &
130
120
110
100
90
80
70
12
15
18
21
24
27
30
33
36
39
42
45
48
5
CHRONOLOGICAL AG
EXPERIMENTAL
CONTROL
CONTRAST

Figure 14

CONTRAST IQ SCORES



V

LEARNING AND PERFORMANCE

The efforts of an increasing number of research programs concerned with the development of preschool age children are now being reported in the literature. Each effort seems to have a particular theme to its assessment program, i.e., the manner in which development was measured. Although such may not have been intentional, the bent of the evaluation program must by its very nature limit interpretation of the results. Furthermore, there is an additional limiting factor to the evaluation of development for this age period which is peculiar to all such attempts, and that is the general availability of comprehensive longitudinal data. Such restrictions should not discourage research in these matters, but act as a stimulus to intensify efforts for developing programmatic, longitudinal comparative research. Indeed a major problem for developmental researchers is the availability of information suitable for reference to groups other than for what seems to be the standard of the field: normal middle-class children. Various attempts at expanding the research population have used such ambiguous references as preschool age children, head start children, mentally retarded, etc., without regard to the host of obvious critical variables that may or may not be associated with the aforementioned general categories.

The implications of this introduction is at once a plea for a re-evaluation of present research in this area and an outline of the difficulties experienced in the development of our research program of preschool age, disadvantaged, high-risk Negro children. Therefore the description of our assessment program will attempt to include not only the results of each of the assessment procedures we have used, but considerable descriptions of the rationale and methodology we employed. By such an approach we in no way attempt to excuse what we have done, but rather to give reason to what we have done, so that the many, we hope, that will be doing such research may gain from our experiences -- both the successes and the mistakes.

It is most important to reiterate that there is a lag in our data at the highest age levels within and between groups. We have pointed out earlier that the nature of the original procedure for assigning children to either the Experimental or to the Control (High-Risk) created, on the average, a 6 month discrepancy between groups and data therefore are often able to be accumulated only for the Experimental group that would be, at best, premature for the Control group. Also, within each group there is still as much as a twenty month discrepancy between the oldest and youngest child which results,at least now, in a discrepancy in the frequency for the data-points beyond the thirty-six month mark. In the past, since so few chronological age data-points had been accumulated with substantial (adequate) frequencies we have been cautious to publish such data in a general fashion and reluctant to be speculative in our interpretation of the results. Although our caution remains, especially regarding interpretation, certain age levels have been accomplished by a majority of children and a somewhat consistent performance record has appeared at the young age levels. What subsequent performance levels may be probably should not be presumed for two reasons: first, because of the nature of the children and the developmental levels they are proceeding through, and secondly, because of the nature of the instruments used to assess such children at such ages.

In the past year and a half, enough of the experimental and control group children came of age so that factorially designed learning paradigms could be implemented. In other words, enough children had reached the age at which they could participate in learning tasks and that we could separate them into sub-groups. In this manner we have been able to expand our knowledge about the differential development of these children's learning process. Obviously, the exceedingly complex nature of cognitive growth cannot be resolved by reliance on a single measure of intellectual development, such as from IQ tests. Rather, a far more comprehensive picture of the growth of cognitive abilities can be obtained by an array of experimental measures, such as that now underway or planned for the coming years.

This section of the report has been divided, as before, into three major areas of the experimental assessment program: 1) learning-performance measures; 2) social-personality development and 3) language development. The development of these three aspects of our assessment program was based on a common rationale. We wanted to know how a child went about responding to his world, and in what areas of his responding was he most or least facile. We avoided as best we could the use of tasks that merely gave us frequency counts--which do not really tell us about the nature of behavior, and are even further reduced in information when submitted to statistical analyses. In the various tasks used, we asked questions about the manner of a child's responding--rather than simply whether or not he responded. Our language program also reflects our attempts to develop a comprehensive picture of early language development--that data for which is unique in that it is longitudinally derived. Several new instruments are being researched and have already proven their sensitivity in assessing differential early language development. Included within each section is a report on the research planned for the coming year.

Learning Tasks

As part of our evaluation program and in an effort to expand our information concerning the nature of the intellectual growth of the children, a series of experimental learning tasks have been designed. These tasks we feel, will not only provide us with a measure of the differential development of the learning process in the children, but increase our understanding of how certain learning variables relate to cognitive growth.

Stevenson and Wright (1968) have reviewed the major learning phenomena of the young child, with particular attention to what is termed response biases. These include, e.g., dimensional preferences such as color vs form; position perseveration or certain response strategies. There are two vital concerns regarding such behavior in the young child: on the one hand, as a function of the design of an experimental task, performance may either be facilitated or interfered with if the particular response biases of the subject are either task relevant or irrelevant (e.g., Suchman and Trabasso, 1966). On the other hand, such response biases are generally accepted as being age appropriate at certain developmental levels, but are expected to either be controlled or 'drop-out' with increasing age. This latter phenomenon, which we shall call a developmentally related shift in response tendencies, has been found to be slowed in low SES children (e.g., Bresnahan, 1966; Horowitz, 1967; Osler and Kofsky, 1967) and mentally retarded children (Corah, 1968). With these considerations in mind the series of tasks employed were designed to evaluate developmentally related response tendencies as well as the differential development of the learning process. It is important to note that the assessment of the children's behavior is essential to the determination of the effectiveness of the "infant-stimulation" program in preventing specific behavior deficits.

As of last year, there had been five scheduled measures, including: color-form matching, sorting, probability discrimination, and an Ivanov-Smolensky discrimination procedure. In most cases, the tasks were used because they provided an opportunity for us to make them increasingly complex over time, i.e., in order to keep pace with the increasing CA's of our Ss while maintaining a continuity of task which would facilitate evaluation of developmental changes in performance.

At this time we have considerably expanded the analysis of the above measures, which has been reported only in a preliminary fashion, and have added to them. The color-form matching, oddity discrimination (Considerably expanded and refined), and Ivanov-Smolensky have been totally replicated. The probability matching task replication is underway. In addition there has been a test of digit span, a test of conservation of number and a test of conservation of quantity.

Furthermore, we now have in operation a new remarkable piece of apparatus - the Wisconsin Learning Research Machine (WLRM). We have devoted considerable attention to this apparatus in the last several months because it has afforded us additional methodological control in our assessment procedure and has provided a means of controlling stimulus program implementation outside of the laboratory with a variety of populations. The WLRM will be described in detail later.

Plans for the coming year will be discussed after the research section. These plans include two new studies and plans for replicating several of the older paradigms. These plans also include expanding our data on other comparison populations (also in the language program as well).

We have divided the children of our total population into four groups (In effect, a 2 x 2 factorial design). There are two IQ levels, High and Low, and two age levels, High and Low. In each case the formation of these groups retained the Experimental and Control children as intact groups. The main purpose of this design was to facilitate testing, since with children at different ages, it would have otherwise taken considerable time to test all at consistently appropriate times. The IQ's of the Low and High groups are approximately 94 (control) and 120.0 (experimental) respectively. The ages are approximately 42 months for the low group and 53 months for the older groups.

Matching as a Function of Color vs. Form Preference

Although color and form preferences have been studied in children as a function of age, little is known about the role of these variables in the learning process at different levels of cognitive development (i.e., as a function of intelligence). In normal children it has generally been found that the younger child initially shows a greater tendency to match on the basis of color, but with increasing age there is a gradual shift to form (approximately 4 1/2 years). Research on the development of response preferences has typically indexed development by chronological age (CA), and has ignored the extent to which such preferences are based in intellectual development (i.e., IQ or MA measures).

Some of the developmental changes in preference for form and color depend on developmentally related changes in the attentional processes, which for example, Luria's work (1963, 1967) on the orienting response (OR) has shown to be a function of the level of cognitive development. Bruner's work (Bruner and Mackworth, 1966), regulating the selection of visual information and eye fixation phenomena in children has demonstrated that varying amounts of attention are needed as a function of the stimulus configuration, and that attention to various aspects of a stimulus configuration change qualitatively with changes in developmental level. Corah (1964, 1966) suggests that it is a developmental attentional process, which operates in a manner similar to what Piaget has conceptually termed centration and decentration, that is responsible for changes in stimulus preferences. In other words, the young child's preference for color is not so much an inability to discriminate forms, rather the child's perception is centered on the dominant characteristics of a stimulus configuration (in this case - color) at the expense of the other characteristics of a configuration. In the older child, perception and judgment become decentered and attention is to all of the characteristics of a configuration.

One experimental task has been concerned with the development of the differential appreciation of the stimulus characteristics (or dimensions): color, form. Brian and Goodenough (1929) found that children between the ages of three and 6 years of age used color as a basis for matching stimuli more often than did older children (i.e., over 6 years of age), while adults matched primarily on the basis of form. This finding has been replicated a number of times, with a general developmental shift from color to form preference occurring around five years of age. Kidd and Rivoire (1966) report that very young children often show a preference for form, then switch to color and eventually back to form. Such research has not really established the role of color-form preferences in early learning. However, what would appear to be most important in very young children is a consistent preference irrespective of the dimension.

There is also evidence (Engel, 1935; Corah, Jones and Miller, 1966; Kagan and Lemkin, 1961) indicating that there is a relationship between intelligence and preference for form in varied stimulus situations. Further, not only do form-preferring children have higher mental test scores; but they are also more accurate in classifying stimuli along dimensions other than form. This shift in preference from color to form accompanies the development of verbal mediation abilities.

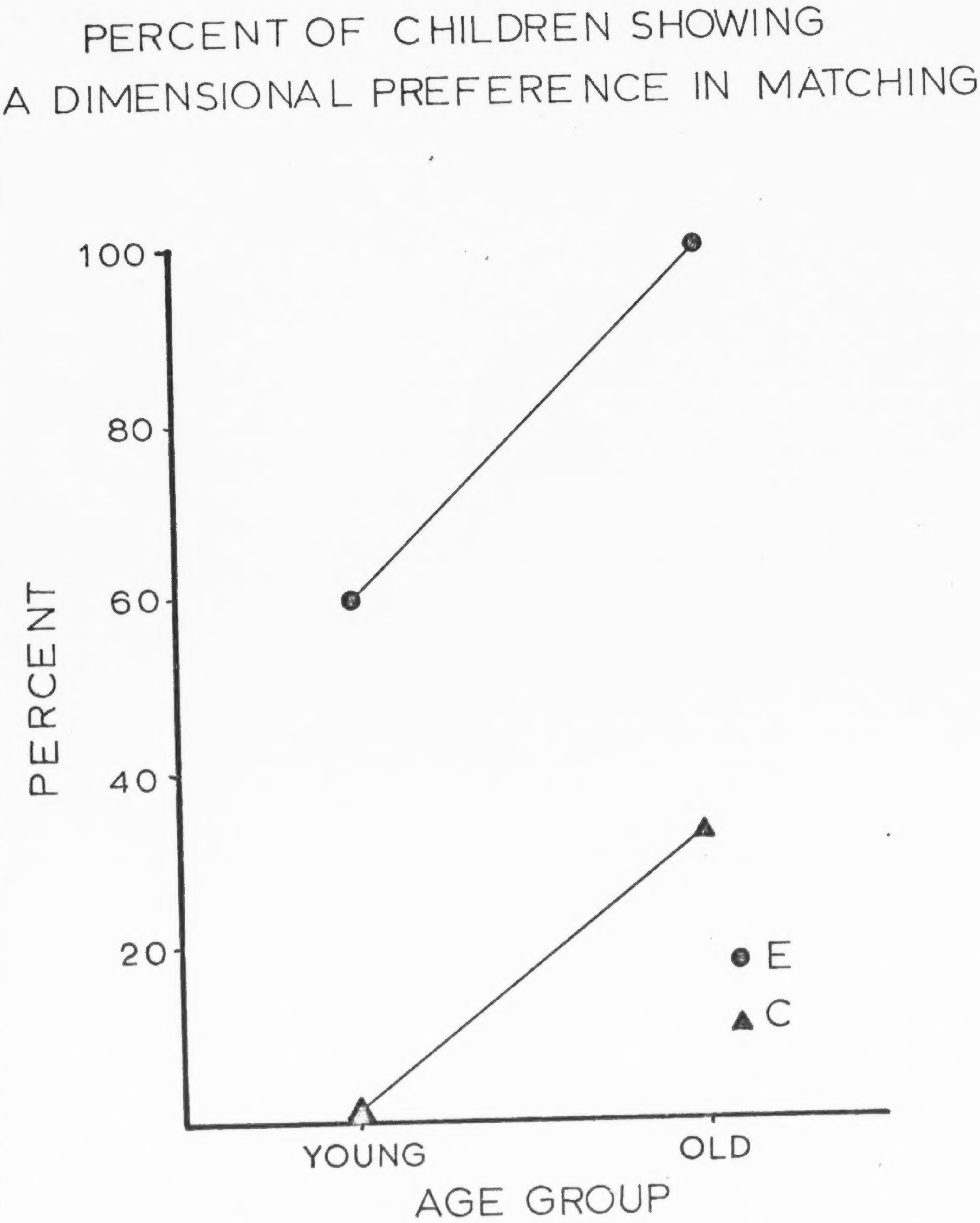
Not only is our concern with the indexing of the developmental changes in color-form preferences, but to determine the individual biases of our subjects. Identification of a preference for the dimension of color vs. form has a number of important implications which must be empirically ascertained. For example, stimulus preference does in fact influence learning rate, possibly by acting as an initial observing response. This is particularly important when a majority of learning tasks utilize stimuli with color and form as their critical dimension and thus can spuriously bias learning rate if relevant dimensions are either consistent or inconsistent with the subject's stimulus preferences. However, when the stimulus-response preference factor is controlled for in learning research, and then groups are compared on learning where the stimulus configurations are varied, then learning performance differences could be attributed more confidently to differential intellectual development.

Apparatus: The stimulus material consisted of colored geometric forms (square, circle and triangle) (red, green, yellow and blue). On each trial the E positioned three stimulus cards on the display panel.

Procedure: A child was asked on each trial to match one of two stimuli to a third, which was the standard. One of these matched the standard in color and the other matched it in form. Order of presentation was randomized (Fellows, 1967) so that a form or color response could not be correct by position preference or alternation responding alone. A preference for a dimension was indicated when 65 per cent or more of the Ss responses were consistently toward one dimension or the other.

Results: Study 1

An analysis of the responses to either the color or the form dimension were not significantly different between groups. On the other hand, the differences in the tendency to show a preference as described above were significantly different ($p < .001$) in favor of the Experimental Children (See Figure 15). In other words significantly more Experimental Children showed a preference than did Control children. The fact that larger differences in color or form preference between groups were not found may be due partly to the large number of position perseverations in the control group. This response behavior resulted in an even number of responses along both dimensions, thereby somewhat dissipating difference in the differential response behavior to color vs. form.



PERCENT OF CHILDREN SHOWING A DIMENSIONAL PREFERENCE IN MATCHING

Figure 15

The results of administering the matching task to the four groups as illustrated in Figure 15 show this remarkable performance difference can be seen in favor of both the younger and older experimental groups. As was suggested earlier, what is perhaps more important at these early ages than demonstrating a preference for either form or color is the demonstration of a unidimensional preference. None of the younger control children and only a third of the older controls showed such response performance. On the other hand, 60 percent of the younger experimentals and 100 percent of the older experimental show essentially (rank of percent or more) unidimensional responding. We feel that in spite of the apparent simpleness of the task, it powerfully demonstrates the association of early intellectual development with the ability to impose order on the environment. This ability is basic to intellectual development. Previous reports of color-form preference have mainly featured the developmental shift in preference, rather than the early development of consistency in dimensional responding. Corah (1968, personal communication) has indicated that lack of unidimensional or consistent responding is characteristic of mildly retarded second and third graders. This difficulty in the performance of a learning task may be similar to the input phenomena discussed by Calfee (1970) in his studies of short-term memory. He suggests that the organization of stimulation for input is most critically lacking in sub-average intellectual functioning.

Results: Study II

The color-form matching task was readministered approximately one year later. The groupings remained the same, and the children are nearly 12 months older. The most interesting finding this year was that there were significant differences in dimension preferences between the Experimental and Control group. The Experimental group showed significantly ($p. < .05$) more form matches than the Control group. The control group made significantly ($p. < .05$) more color matches (See Figure 16). The general result is that demonstrating a preference to match on the form dimension is consistent with increasing IQ levels. However, whereas the number of color and form preferences in the Experimental group have remained constant, it is the Control group which has increased their performance in the last year. On this task improvement is a relative description since choosing either color or form is not "right" or "wrong." Rather it is making a preference and demonstrating consistency in one's choice that suggests improvement or good performance. In this case, the improvement on the part of the controls brings them to level that Experimentals had attained the year before.

In addition to the age change for each of the subjects-the groupings remaining relatively intact-the stimuli were displayed on a new apparatus. This apparatus will be more fully described later. The essential difference in procedure for this study was that stimuli were automatically displayed on a screen. A response was made by pressing a button directly beneath the screen. It is, for the most part, impossible to estimate the effect of this procedure change a year later on the matching performance of the children. Last year the stimulus cards were immediately before the subjects and therefore could be responded to directly. It could be argued that this

Figure 16

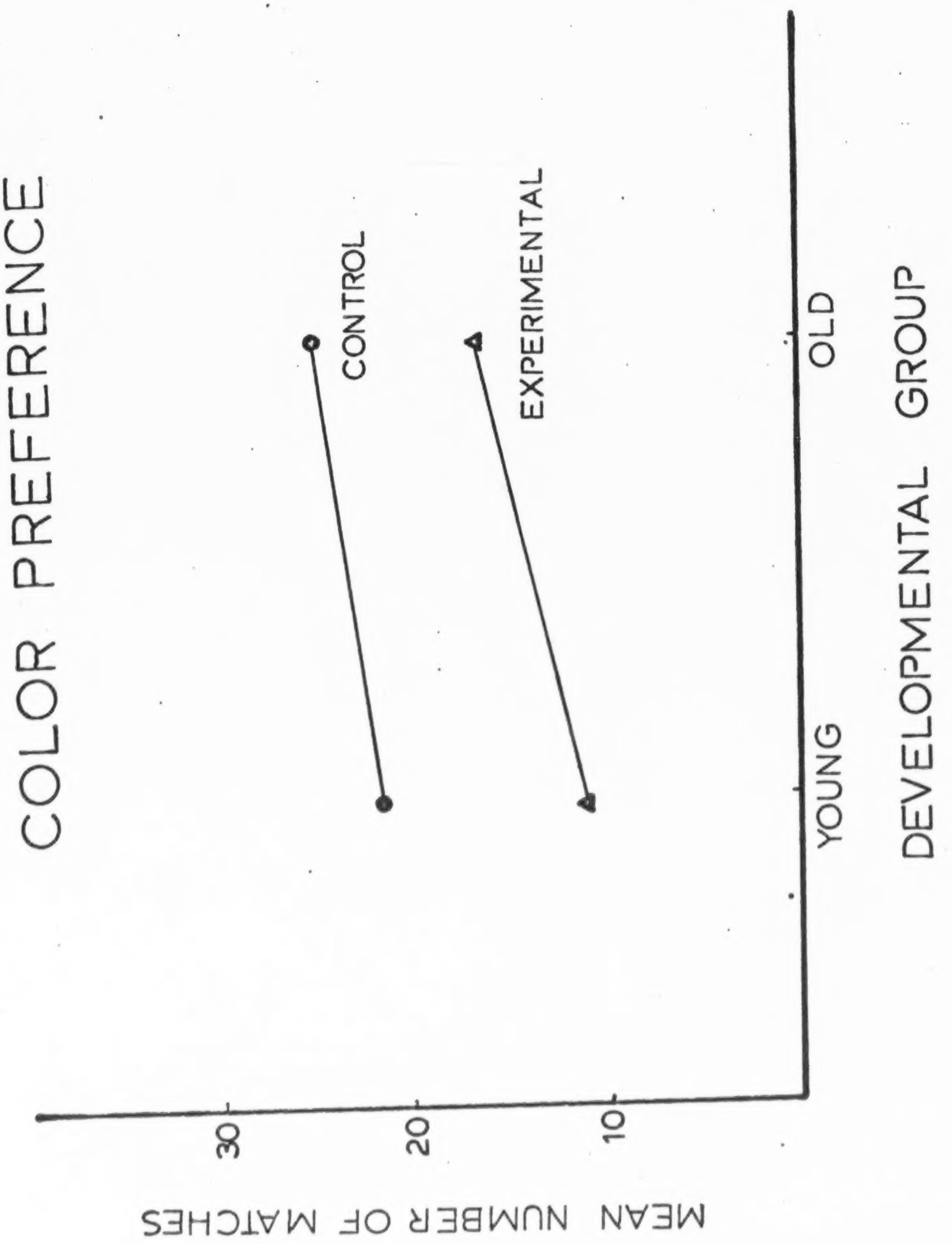


Figure 16

somewhat enhanced the form dimension, while in this year's project the stimuli enhanced the color dimension. If so, it may have done so differentially - in that the Experimentals' general preference for form demonstrated by last year's 66% compared to this year's 65% was not effected. However, the controls showed a considerable increase in preference for color this year to 59%, up from about 9% last year. The fact remains that the controls are about a year behind in performance. Last year, nearly 80% of the Experimental showed a preference, and now a year later, only 70% of the controls show a preference (as compared to .100% this year for the Experimentals) (See Figure 17).

Assessment of Color Form Preference: Sorting

A second task is concerned with the possibility of different response processes operating to influence stimulus preference. The children are administered a card sorting task which utilized the same basic stimuli as the original matching task previously described. The premise upon which this task was based is that children should show the same stimulus preference biases and response tendencies where the same stimuli are used, even though the form of the response changed. In the first task, the children had to simply point to the matching stimulus they think is the same as the standard. In this task, they are given a stack of colored geometric forms, which in the first task would have been the standard. In two windows of a sorting box, the two sample geometric figures were exposed, one of which matched the stack of cards in color while the other matches it in form. The child was then asked to put the cards into the compartment that had the same picture in front as the card in their hand. This task should be more difficult if the fact that the orientation of the cards was not fixed nor positioned in such a way as to facilitate relational responding, i.e., in the manner of the matching task.

An inspection of the data indicated considerable position responding by both the older and younger controls. Approximately 50 percent (see Figure 18) of the older controls showed unidimensional preference in sorting, an increase from the matching task. However, 91 percent of the Experimental older group showed unidimensional responding, and no position responding at all. Both of the younger groups were comparable, except for increased evidence of positional responses by the younger control children.

Assessing Response Strategies as a Function of Differential Reinforcement

What appears to be extremely important for the individual's future performance is the behavior style or strategy developed in his early years. Increasing research evidence (e.g., Kofsky and Osler, 1967) indicates that low SES children show an insensitivity to the reinforcement contingencies of a problem situation, i.e., a lack of appreciation of the feedback to be gained from their responses in a problem-solving situation. The nature of the origin of this behavior is our concern.

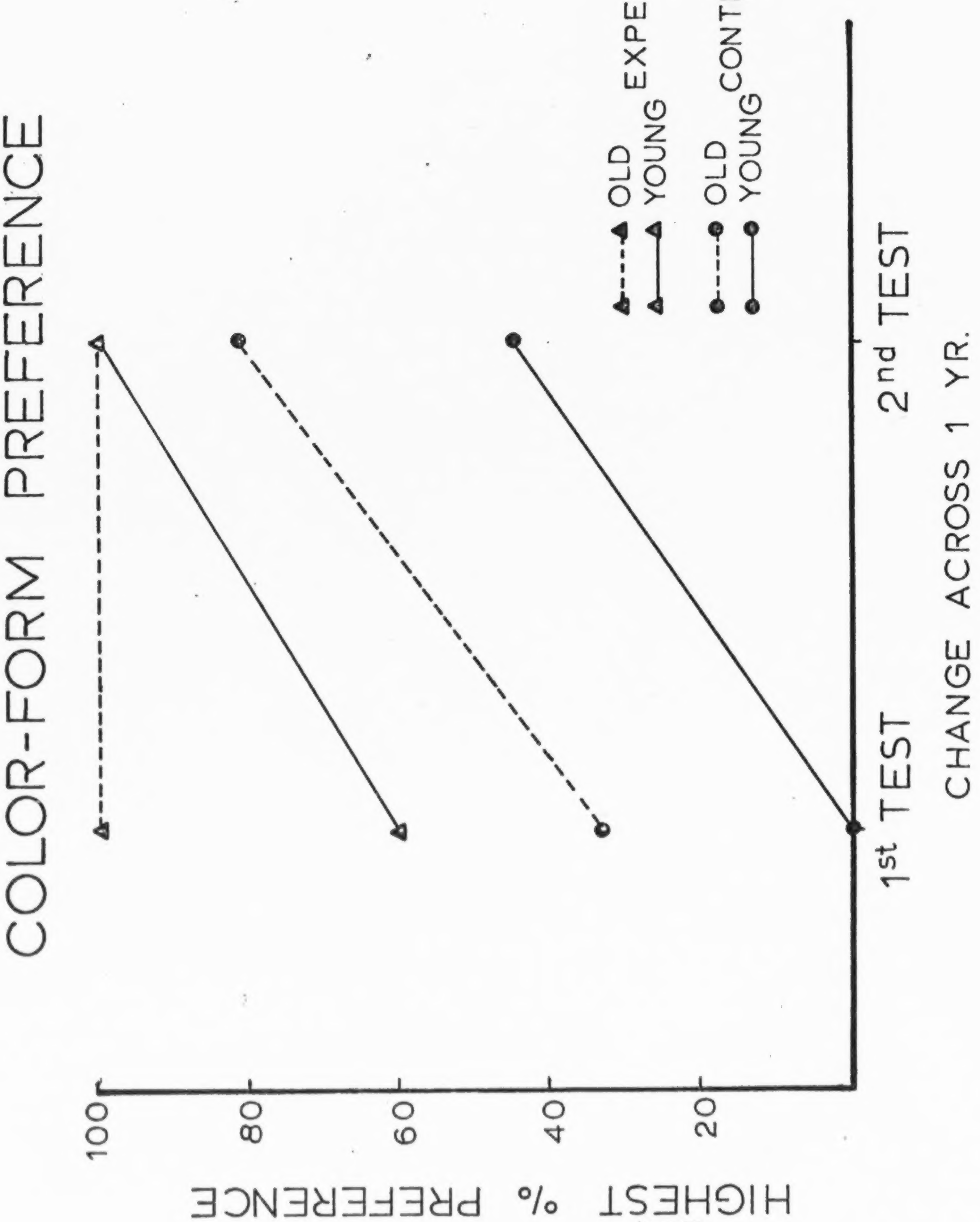

COLOR-FORM PREFERENCE
HIGHEST % PREFERENCE
100
80
60
40
20
1st TEST
2nd TEST
CHANGE ACROSS 1 YR.
OLD
YOUNG
EXPER.
OLD
YOUNG
CONTROL

Figure 17

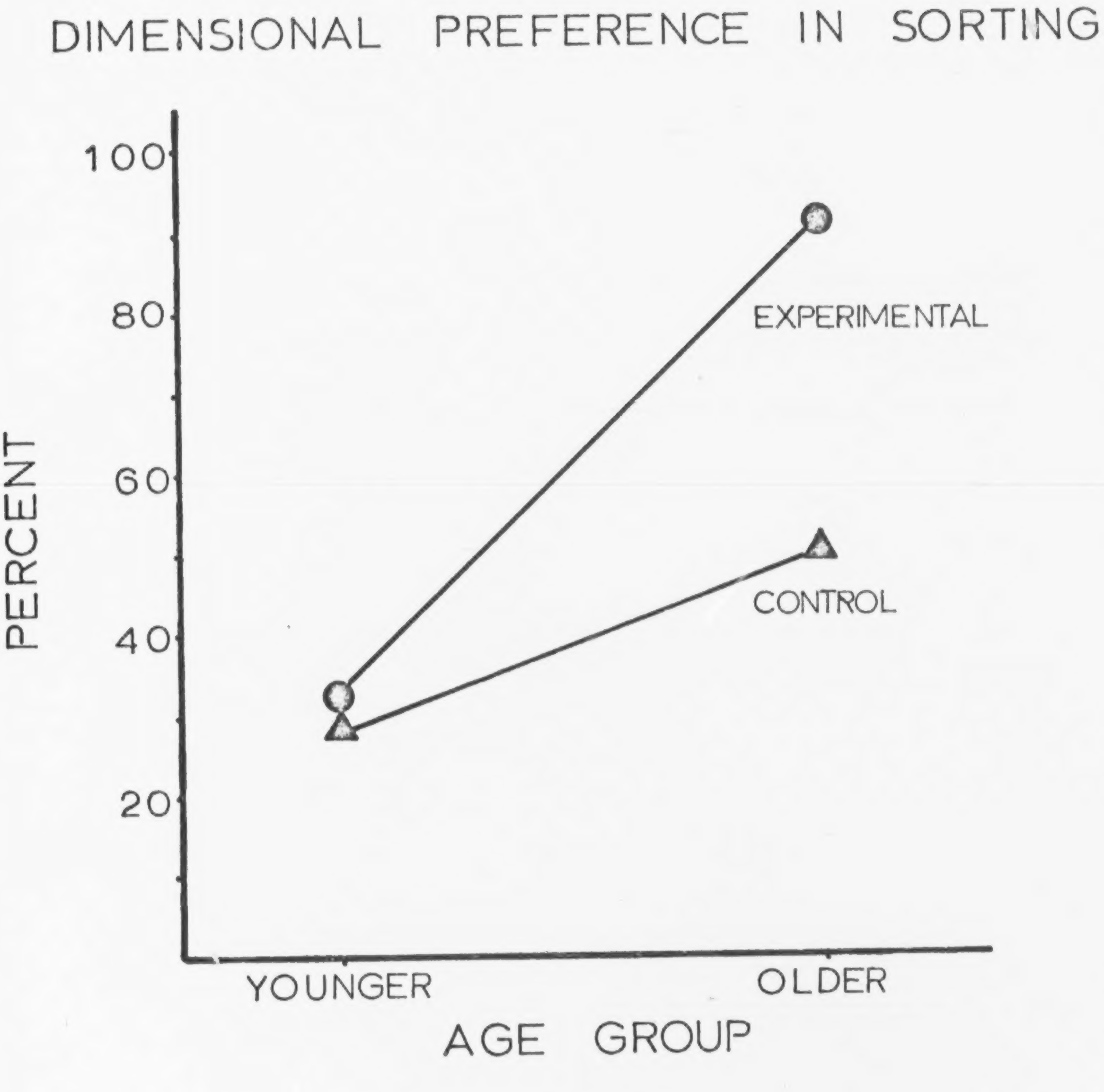

DIMENSIONAL PREFERENCE IN SORTING
100
80
60
40
20
PERCENT
EXPERIMENTAL
CONTROL
YOUNGER
OLDER
AGE GROUP

Figure 18

Relatively little research has been concerned with the early development of children's decision-making and problem-solving strategies. The study of research into this performance is particularly important to all other learning-performance characteristics of very young children, as well as being relevant to day to day life. For adults and older children, decision-making is usually influenced by evaluating the expected probabilities of a range of outcomes based on previous experiences which had similar configurations and sequencing of events (Weir, 1967). The young child who has had only restricted opportunity to select among alternatives in general situations cannot be expected to exhibit much control over environmental events. Attempts to evaluate the development of problem-solving strategies have utilized two-choice and three-choice discrimination problems. Usually such tasks are arranged so that stimulus events appear random and have no solution, but the subject actually is provided with the opportunity to maximize reinforcement, and therefore demonstrate the individual's attempts at solution. Typically, very young children will search for solutions and change strategies over many trials. However, such response behavior allows the investigator to study a child's "mode of attack" in the problem.

Performance on probability learning tasks varies, i.e., strategies change, as a function of age (Weir, 1964; 1967) and intelligence (Harter, 1967; Moffit and Coates, 1969). Weir (1964), for example, used a three-choice task in which one alternative was intermittently reinforced 33% of the time while the other two choices were never rewarded. He found that the youngest children (3 1/2 - 5 years) in his sample appeared to respond like adult subjects in that they chose the button reinforced 33% of the time as often as adults. However, when he analyzed performance by trial blocks, he found that the 3 year old Ss level of responding to the payoff button during the final block of trials approached their level of responding in the initial phase of the task. On the other hand, the adult subjects showed a gradual but steady increase in responding, and did not reach their asymptote until late in the task. In other words, while the overall rates of responding to the reinforced stimulus were the same for both groups, Weir concluded that 3 year olds performance was simply a function of differential reinforcement and a strengthening of the response to the payoff button, rather than performance based upon formulating and testing hypotheses, as is more characteristic of adults and older children. Using a two-choice apparatus, Weir (1966) has found children's choice behavior to follow a well-defined progression in response complexity. Three year old children tended to use maximization in attempted problem solution, i.e., selecting the more frequently reinforced stimulus. A strategy typically used by four to six year olds, but rarely seen in younger Ss and children 12 years of age and older, is single alternation. In this case, the stimulus chosen on a given trial is different from that chosen on the preceding trial. This strategy is more characteristic of that used by adults in the early stages of a problem solution.

The present study was designed to explore the probability learning strategies in the children who have participated in our early education program. In general, the research has shown that children from such low SES backgrounds have less well-developed cognitive abilities than their middle class peers (e.g., Hess and Shipman, 1965). These results have usually been explained in terms of their cultural disadvantagement, in that the lower class child has not been exposed to as many different experiences as those common to the life of the middle class child. Thus the development of his cognitive ability is restricted at a critical period of life, leading possibly to an early plateau in cognitive development short of that which can potentially be achieved by middle class children.

Problem-solving strategies show a change in complexity developmentally, i.e., as a function of age and IQ. The use of sophisticated strategies in problem-solving tasks is considered to be a reflection of the development of higher level intellectual processes at higher age levels, while the use of perseverative strategies is associated with punitive cognitive functioning. This study examined the choice behavior and the development of hypothesis testing in children younger than four years of age, as well as the influence of SES. If socioeconomic status does in fact act to modify basic cognitive processes, it was expected that the experimental subjects as a group would show more complex strategies than a comparable control group of children from the same socioeconomic level who have not participated in the educational program. Further, it was expected that not only would the use of complex strategies increase with increasing chronological age, but that the Experimental subjects at any given age would demonstrate more of such strategy behavior than the control Ss as a function of their differential level of cognitive development.

METHOD

Subjects

The subjects in this experiment consisted of all children in the age range from 24 to 48 months (N=36) involved in the project. The Experimental group participates as subjects in the daily program, while the Control subjects have not.

In order to facilitate evaluating effects of the variables of age and intelligence on developmental problem solving strategies, the groups were divided on the basis of chronological age into Young and Old subjects. The Experimental Group, on the basis of IQ tests in particular, is developmentally well advanced beyond the Control group. As measured by the Stanford-Binet Form L-M, Revised, 1960, and the Cattell Infant Intelligence Scales, mean IQs for the total Experimental and Control groups, irrespective of age, are 125.9 (range 94-137) and 93.7 (range 73-119) respectively. Chronological ages for all subjects were calculated as a function of the date the study began. Number, mean ages, and mean IQs for the four groups are presented in Table 7a

Table 7a

NUMBER, MEAN CHRONOLOGICAL AGE, AND MEAN IQ OF CHILDREN IN EACH GROUP

	Number	Age (Years, Months)	IQ
Young High IQ Ss	10	2-7	122
Old High IQ Ss	11	3-9	130
Young Low IQ Ss	9	2-9	95
Old Low IQ Ss	6	3-7	91

Design

The breakdown of the Experimental and Control groups by CA resulted in a basic two (High IQ vs. Low IQ) by two (young vs. old) factorial design.

Apparatus

The stimuli for the two-choice probability task consisted simply of 2 inch red and blue squares presented in a modified WGTA apparatus. E arranged the stimulus cards behind a wooden screen before presenting them to the S on a sliding wooden tray. On the tray there were two movable plexiglass windows mounted, which contained the stimuli. Under each window was a well which could be baited by a colored marshmallow. Only one well was baited on each trial of the task.

Procedure

After each S was seated, E stood behind the apparatus and pushed the tray into view with the food wells covered by the stimulus cards placed in the plexiglass windows. S was then told:

> We are going to play a game. I am going to show you two pictures, a red square and a blue square (point to both). Every time I show them to you I want you to choose one of the pictures by pointing to it. If you guess the right picture, you will get a marshmallow (windows were pushed back to reveal baited wells). Remember you only get a marshmallow when you choose the right picture. Try and win as many marshmallows as you can.

Following the instructions, the tray was removed from S's view and the stimuli were arranged for the first trial of the experiment. Each S received 96 trials all in one session. Position perseverators were discontinued after making 72 consecutive responses to the same side of the stimulus array.

Positions of the stimulus cards were randomized by using modified Gellerman sequences (Fellows, 1967) ending in 11, and 22 with others beginning in 22, and 11 respectively. These sequences are the most satisfactory in terms of ensuring a chance level of performance for position perseveration and position alternation, and minimizing the reinforcing effects upon these hypotheses. Choosing the blue square would be reinforced on 66 percent of the trials, while choosing the red stimulus would be reinforced on 33 percent of the trials. Neither stimulus followed itself in the same position more than three times, and in no case was a stimulus reinforced on the same side more than six consecutive times.

Data Analysis

Three dependent measures were derived: (1) the number of correct responses and (2) the number of response changes made to the stimulus dimensions of (a) position and (b) color. A correct response score was any response to a stimulus which was reinforced. The change score for the position dimension of the task is derived from the number of times a subject altered his choice of a stimulus from the one on the right to the one on the left, and from the left to the right. The change score for the color dimension was derived from the number of times a subject chose the blue stimulus after previously selecting the red square, and the number of times he selected the red card following a choice of the blue. These three scores were obtained for each of eight task phases (successive 12 trial blocks) and for the total task length.

The primary task measures were eight strategy scores, divided into four each, for the position and the stimulus dimensions of the task. The eight strategy indices are described below for each task dimension. Each strategy is defined in terms of reinforcement or non-reinforcement on one trial (win or lose); the outcome of this (stay or shift); and reinforcement or non-reinforcement on trial two, and the outcome on trial three. Although the relationship among three discrete events are described, actually there are but two, since event acts both as the stimulus for the response occurring on the following trial, and the response to the outcome of the preceding trial.

Position

(1) Win-Stay: Lose-Stay -- This strategy appears when a subject chooses a reinforced stimulus on one side, and then selects the non-reinforced stimulus on the same side on the next trial (lose), and then stays with the stimulus appearing on this same side for the following trial. This strategy behavior is referred to as perseveration.

(2) Win-Stay: Lose-Shift -- A strategy which results from initially selecting a reinforced stimulus on one side, following this choice by remaining on the same side to choose a non-reinforced stimulus, and then shifting the stimulus choice to the stimulus on the other side. In order words, if the S wins he stays with that position as his choice, but shifts when he loses.

(3) Win-Shift: Lose-Stay -- In this strategy, the subject selects a reinforced stimulus on one side, then changes his choice to the stimulus which appears on the other side of the array on the next trial, but if the stimulus is not reinforced, then on the next or third trial remains on the same side without shifting. In other words, each time the S wins he shifts to the other side on the next trial, but if he loses he stays with that position.

(4) Win-Shift: Lose-Shift -- This strategy is merely alternation. In this case if the subject chose a stimulus which appeared on the right side, then his following choice would be the stimulus on the left side, regardless of the reinforcement.

Stimulus Color

(1) Win-Stay: Lose-Stay -- This strategy appeared when a subject selected the blue stimulus, for example, on three consecutive trials, irrespective of either its position or whether they were reinforced or not. Since the incentive value (reward) of the color blue and red are different (as function of the reinforcement schedule), this strategy provides a measure of the tendency of subjects to maximize. If a subject maximizes, then he would select the more frequently reinforced stimulus most or even all of the time. In other words, he tends to follow reinforcement. For example, if a S selected the blue stimulus 61 to 71 percent of the time, he would be maximizing since his selection rate is approximating the reinforcement schedule of one of the stimuli.

(2) Win-Stay: Lost-Shift -- In this strategy the subject would select, for example, the red square initially and if it is reinforced would again select the red stimulus square, which if then unrewarded, would follow this choice with selection of the blue card. In other words, the S remains with the color as long as it is rewarded, but shifts to the other color on the next trial when this choice is unrewarded.

(3) Win-Shift: Lose Stay -- In this strategy the subject might choose the red square initially, but would follow this choice by choosing the blue stimulus if the red is reinforced. The subject remains with a color only if the color is not reinforced.

(4) Win-Shift: Lose-Shift -- In this case the subject chooses the other color on each successive trial, irrespective of the reinforcement reward outcome of his choice; i.e., he alternates.

The eight strategy scores described above were computed separately for the position and color dimensions. The data were scored on the basis of staying or shifting from any n+1 response (where n+1 = the selection the subject made on trials two through 96) as a function of winning or losing on the n th response (where n = the stimulus choice on trials on through 95). For example, if the subject chose the reinforced stimulus on the left which happened to be blue on the first trial, and selected the red stimulus on the left position on trial two, he would be scored as showing a win-stay for the position dimension, and a win-shift for the color dimension.

The strategy scores of win-stay or -shift and lose-stay or -shift were combined to form the strategy indices. For example, if a child demonstrated the following breakdown of responses win-stay = 62, win-shift = 1, lost-stay = 13, lose-shift = 19, his strategy index scores wouldbe win-stay: lose-stay = 75, win-stay: lose-shift = 81, win-shift: lost-stay = 14, and win-shift: lose-shift = 20.

RESULTS

Performance Measures

Correct Responses

An analysis of variance of the total number of correct responses for the position dimension revealed no significant F values for the factors of Age and IQ. The comparison across blocks of 24 trials for High and Low IQ subjects, and Young and Old subjects on correct number of responses showed comparable performances. (See Table 8a)

Table 8a

MEAN NUMBER OF CORRECT RESPONSES FOR
POSITION BY BLOCKS OF TWENTY-FOUR TRIALS
COMBINED AGE AND IQ GROUPS

Group	B_1	B_2	B_3	B_4
High IQ	12.9	12.4	12.6	13.0
Low IQ	12.2	12.3	12.4	12.5
Young	12.5	12.4	12.4	12.6
Old	12.8	12.2	12.4	12.6

Response Change Scores

An analysis variance performed on the change scores for position revealed significant main effects for IQ ($F=18.34$, $df=1$, $p < .01$) and Age ($F=10.34$, $df=1$, $p < .01$).

An inspection of Table 9 indicates that the High IQ groups exceed the Low IQ groups by nearly twofold, with Old High IQ nearly fourfold beyond the higher performing younger low IQ group. While Young High IQ Ss made fewer response changes than the Old High IQ group, their performance was superior to that of either the Young or Old Low IQ groups.

Table 9

MEAN NUMBER OF RESPONSE CHANGES

	AGE	
	Young	Old
High IQ	13.7	35.72
Low IQ	8.7	6.38

Both Young and Old Low IQ subjects made approximately the same number of response changes. Comparison of mean response changes across trial blocks indicated a general but slight decrease in the frequency of response changes for all groups.

Analysis of variance of response changes for the color dimension revealed no significant effects for the factors of Age and IQ.

Strategy Measures

Since win-stay: lose-stay (perseveration) and win-shift: lose-shift (alternation) are reciprocal response strategies, as are win-stay: lost-shift and win-shift: lose-stay, it is only necessary to report results in terms of one pair on non-complementary strategies or the other. In this study, data will usually be presented in terms of position and stimulus win-stay: lost-stay and win-stay: lost-shift, thereby permitting comparison of one strategy occurring independently of outcome: win-stay: lost stay; with a second strategy: win-stay: lost-shift, which is determined by outcome. Four separate analyses of variance were performed on the position and color strategies of win-stay: lost-stay and win-stay: lose-shift.

Win-Stay: Lose-Stay -- For position perseveration (win-stay: lose-stay) significant effects were obtained for both IQ (F=16.92, df=1, 35; $p < .01$) and Age (F=9.26; df=1, 35; $p < .01$) factors. The Old High IQ Ss showed the lowest rate of position perseveration. An inspection of the mean rate of position perseveration for all groups showed that the young groups were comparable (Young High IQ: x=86.4; Young Low IQ: x=86.67) in their use of the win-stay: lost-stay strategy. However, the older groups were substantially different (Old High IQ: x=59.36; Old Low IQ: x=88.17) in rates of perseveration, with the Old High IQ using the win-stay: lost-stay strategy less frequently. In fact, the Old Low IQ children were comparable to both the younger groups.

For perseveration in terms of stimulus color, no significant effects were obtained.

Win-Stay:Lose-Shift -- Analysis of the win-stay: lose-shift strategy for position indicated significant effects for the Age factor (F=40.84; df=1, 35; p < .01). The anslysis of variance of the IQ factor revealed F values as significant at p < .10. This strategy was most frequently used by the Old High IQ subjects ($\bar{x}$=61.27). The frequency of use of this strategy was almost comparable among the other three groups (Old Low IQ, $\bar{x}$=51.67; Young Low IQ, $\bar{x}$=51.11; and Young High IQ, $\bar{x}$=52.10).

The only significant effect obtained for the win-stay: lose-shift strategy on the dimension of stimulus color was for the factor of Age (F=12.293; df=1, 35; p < .01). The older subjects, across both IQ groups, used this strategy more frequently than either group of younger subjects.

Rank Order and Percentage Distribution

In order to obtain a measure of frequency of use for each of the four strategies for the two dimensions of position and color, the total strategy scores were rank ordered separately by task dimensions. As indicated in Table 10, the order of strategy preference for the three groups designated Young High IQ, Young Low IQ, and Old Low IQ was: (1) win-stay: lose-stay, (2) win-stay: lose-shift, (3) win-shift: lose-stay, and (4) win-shift: lose-shift. Only the Old High IQ group deviated from this order, showing a preference for win-stay: lose-shift, followed by win-stay: lose-stay, win-shift: lost-shift, and win-shift: lost-stay in that order. Comparing the strategies of win-stay: lose-stay and win-stay: lose-shift for the Old High IQ subjects indicated that the difference in relative use of the two strategies was non-significant (t=.356, df=10).

Table 10

RANK ORDER OR STRATEGIES FOR THE POSITION DIMENSION

Group	ws:ls	ws:lsh	wsh:ls	wsh:lsh
Young High IQ	1	2	3	4
Young Low IQ	1	2	3	4
Old High IQ	2	1	4	3
Old Low IQ	1	2	3	4

Conversion of derived strategy index scores to percentages (Table 11) reveals that only the Old High IQ group differed in relative rates of responding in terms of the four strategies. The three remaining groups used win-stay: lose-stay as a strategy 40 to 45 percent of the time, while Old High IQ subjects used position perseveration only 31 percent of the time.

Table 11

PERCENTAGE DISTRIBUTION OF STRATEGIES FOR THE POSITION DIMENSION

Group	ws:ls	ws:lsh	wsh:ls	wsh:lsh
Young High IQ	42.84	27.42	22.58	7.18
Young Low IQ	45.56	26.87	23.13	4.44
Old High IQ	31.24	32.25	17.75	18.76
Old Low IQ	46.40	27.19	22.81	3.60

Rank ordering of strategy indices in terms of stimulus color (Table 12) indicates the identical order to strategy preferences for each of the groups as that shown for the position dimension.

Table 12

RANK ORDER OF STRATEGIES FOR THE COLOR DIMENSION

Group	ws:ls	ws:lsh	wsh:ls	wsh:lsh
Young High IQ	1	2	3	4
Young Low IQ	1	3	2	4
Old High IQ	2	1	4	3
Old Low IQ	1	2	3	4

A percentage breakdown of the strategy indices (Table 13) resulted in a fairly even distribution in use of the strategies by each of the four groups.

Table 13

PERCENTAGE DISTRIBUTION OF STRATEGIES FOR THE COLOR DIMENSION

Group	ws:ls	ws:lsh	wsh:ls	wsh:lsh
Young High IQ	27.05	24.42	25.58	22.95
Young Low IQ	27.28	24.82	25.18	22.72
Old High IQ	25.50	29.81	20.19	24.50
Old Low IQ	27.54	27.28	22.72	22.46

DISCUSSION

The investigation of differential development of choice behavior as a function of age and IQ in young children revealed: (1) no differences in amount of reinforcement gained (i.e., number of correct responses) by any of the developmental groups; and (2) significant differences in the choice behavior or strategies employed by developmentally different groups of children.

The fact that there were no increases in the mean number of correct responses across trials for children in the age range studied is consistent with the developmental hypotheses of Weir and the findings of other investigators (Weir, 1967). Children three to four years of age have usually attained in the first ten to 20 trials of the task a level of performance (i.e., number of correct responses) approaching the performance of adult Ss in the final phase of their task. Performance, according to the initial and final selection rate (i.e., frequency counts) of the correct response, for all the groups was at a rate consistent with chance levels. This indicates that the Ss failed to adopt a maximizing strategy often used by young children. In this type of discrimination task, wherein reinforcement is randomly arranged, maximization of reinforcement is the only "solution" possible.

Furthermore, the failure of the older High IQ subjects in particular to achieve a higher rate of correct responses does not support the contention of Moffitt and Coates (1969) that there are IQ associated differences for this performance measure. However, studies which have found an increase in correct responses across trials (e.g., Harter, 1965, 1967; Zeaman and House, 1960; Moffitt and Coates, 1969) used a wide range of IQs, MAs and CAs and thus made comparison to our study difficult.

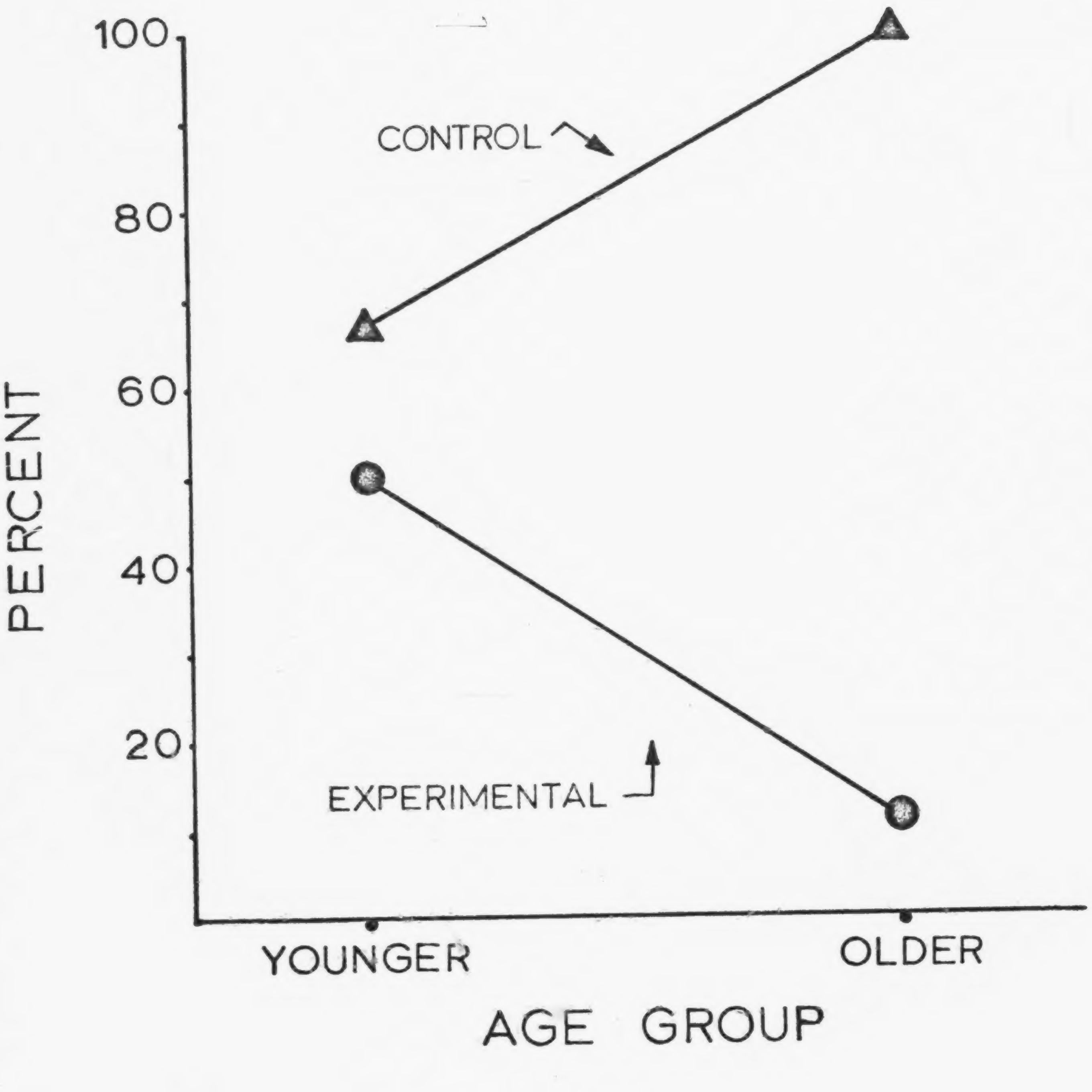
The absence of maximization in all groups suggests that subjects irrespective of Age and IQ were responding to position rather than stimulus color. Thus the subjects appeared insensitive to the differential reinforcement of the two stimuli, failing to discriminate between 66 percent reinforcement and the chance level of 50 percent, which they could obtain by perseverating on the position dimension.

On the other hand, this study differs from the procedure and apparatus in Weir's (1967) study wherein the procedure favored use of maximization as a strategy. In his study, responses to several levers were reinforced, with each lever having a different reinforcement value throughout the task. Since the position of each lever did not vary, what Weir refers to as maximization of reinforcement is a position reinforced response. Since presentation of two stimuli were randomized for the variable of position in the present study, in order for a subject to maximize,he needed to systematically eliminate the irrelevant variable of position, and respond in terms of the more salient task dimension of color. Then once he began responding to the critical dimension, he could then discover which was the more frequently reinforced stimulus. This behavior demands the systematic formulation of a series of hypotheses and their rejection when faced with disconfirming evidence. It is certainly more difficult than finding one lever which yields the greatest reinforcement. An additional factor, considering the lack of maximizing as a strategy among these subjects, it may well be that such young children find 66% and 33% a difficult ratio to discriminate between. If this is a major contributing factor then a replication effort would be in order wherein the reinforcement schedules are more discrepant, e.g., 75% -- 25%.

The low frequency of response changes for both Young and Old Low IQ subjects is related to their tendency to perseverate on the position dimension. Even more striking is the low rate of response changes for the Low IQ subjects in both age groups. In spite of the fact that the Young High IQ subjects and Old Low IQ subjects are fairly comparable in their use of the win-stay: lose-stay strategy, these groups differed greatly in frequency of response changes. Young High IQ subjects made twice as many changes as Old Low IQ subjects. Indeed, such a finding might suggest an increasing tendency toward perseverative behaviors.

The results of the strategy measures indicated both Age and IQ associated differences in strategy behavior. The analysis of the position perseveration strategy revealed a strong tendency for three year old subjects, irrespective of IQ, and four year old Low IQ subjects to respond in a relatively stereotyped fashion. Four year old High IQ subjects used the search strategy of win-stay: lose-shift about as often as they used the win-stay: lose-stay strategy. Use of the perseveration strategy by four year old Low IQ subjects may be associated with the expectancy for failure that has been observed in retardates and lower class children. Children with a background of failure are less likely to search for a perfect solution and more willing to settle for the partial reward resulting from selection of the stimulus in the same position on every trial. With a history of more than three years of intensive educational enrichment, Old High IQ subjects may approach the problem expecting that there is a solution which will yield 100 percent reinforcement, or which is at least 100 percent predictable, and utilize a search strategy to discover it.

The high frequency of position perseveration among High and Low IQ three year olds is characteristic of this age group but it is regarded as a rather primitive strategy because it occurs independently of outcome on the previous trial. Position perseveration has been found in infrahuman species such as rats (Krechevsky, 1932; Lashley, 1929), chimpanzees (Gellerman, 1933). Additional research with human subjects has found high rates of perseveration in young children (Hively, 1962; White, 1964), retardates (Ellis, 1958), and elderly persons (Levinson and Reese, 1963). Use of a win-stay:lose-shift strategy, on the other hand, is positively correlated with ontogenic level of development. It is viewed as a sophisticated strategy which involves both hypotheses formulation and testing, and the mediational process of short-term memory. Thus, equivalent rates of use of the two strategies of win-stay: lose-stay and win-stay: lose-shift by the Old High IQ group may be taken as an inclination that these subjects are more advanced in cognitive development than Old Low IQ subjects and may be gradually shifting from the stage in which perseveration is the dominant or preferred strategy to one in which complex prediction hypotheses are entertained. (See Figure 19).



ERSEVERATION IN PROBABILITY TASK

Figure 19

Assessment of Concept Utilization: Oddity Discrimination

This experiment studied the performance of the children on a three-position oddity discrimination. The typical oddity task presents the subject with a horizontal array of three stimuli, one of which is discrepant. The subject must learn to select the odd stimulus on each trial, but he must be aware which stimulus dimension is odd and which dimensions are not. In effect, the subject must learn to respond to a difference relation between the odd object and others of a set (House, 1964). However, to do this he must separate the variable dimensions (relevant and irrelevant) from the quiet dimensions and then select the relevant dimension while discarding the irrelevant. Harlow (1958) has suggested that the oddity problem is too difficult a problem for young children, although developmental data concerning this learning process is not available. In addition, there is a developmentally related ease with which certain concepts are attained (e.g., Huang, 1945): form, color and number fall along a dimension, with number being the most difficult concept to attain. However, these findings are not satisfactorily generalized to all children since the development of such concepts has not been well documented. It is one thing to match on the basis of a preference for one dimension over another, but it is another matter to demonstrate the appreciation of these concepts in a discrimination task, in which the stimulus material varies along two or more dimensions. We investigated the differential ease of concept utilization as a function of developmental level. There were four conceptual dimensions: color, size, form and number, and in each case one of the dimensions was relevant, one was irrelevant, two were quiet and varied continuously. This was the case for all stimuli. The fact that concept oddity discrimination is a developmentally related complex learning ability (Lipsitt and Serunion, 1963) reveals itself particularly when a number of distracting variables are also used (Gallin, Saravo and Salten, 1967).

Method

There are three defining conditions for the oddity task procedure: (1) the odd stimulus was located in any of the three positions and always reinforced; (2) each dimension was correct on an equal number of trials; and (3) the subject was permitted only one choice on each trial.

The stimuli consisted of 18" x 24" cards on which were pasted felt pictures of common objects such as a truck, chair, and bicycle. There were four cards per set. In each set of pictures there was one dimension critical to problem solution. Each set of stimuli also varied along another dimension which was irrelevant to solution of the oddity problem, and two dimensions which were quiet. For example, if color was the relevant concept, then the following three items might be presented: one large blue triangle, one medium blue triangle, one small green triangle. In this example, number and form are quiet, size is irrelevant and color is relevant.

The basic stimulus dimensions to be used in this task are color, size, form and number. Each stimulus dimension occurred in the trial sequence as both the critical and nonrelevant factor in problem solution. The position of the odd stimulus was altered so that it appeared in the three possible positions: left, middle and right randomly.

At the beginning of the experimental period, the subject was told: "I am going to show you some pictures, and I want you to point to the picture that is different." This was repeated prior to the presentation of each array of stimuli.

As can be seen in Figure 20, the group's performance is superior to the control group. An analysis of variance revealed this difference was significant at $p < .025$ level. Older children were significantly superior to younger ($p < .05$) but the main support for their performance is due to the older experimentals, since the younger experimentals exceed both control groups.

An analysis of variance was performed on each of the dimension categories of color-relevant, form-relevant, size-relevant and number-relevant. The experimental group made significantly ($p < .05$) more correct responses in both the color-relevant and form-relevant categories. There were no other significant differences (see Figure 21). The performance of the younger experimentals was in general superior to even the older controls, with exception of the size-relevant category. In the color-relevant category, the preference for color demonstrated earlier by the young experimental group may have helped their performance to a level comparable with the older experimentals. The older experimentals performed best on the form-relevant sets. Number was the most difficult set for all groups.

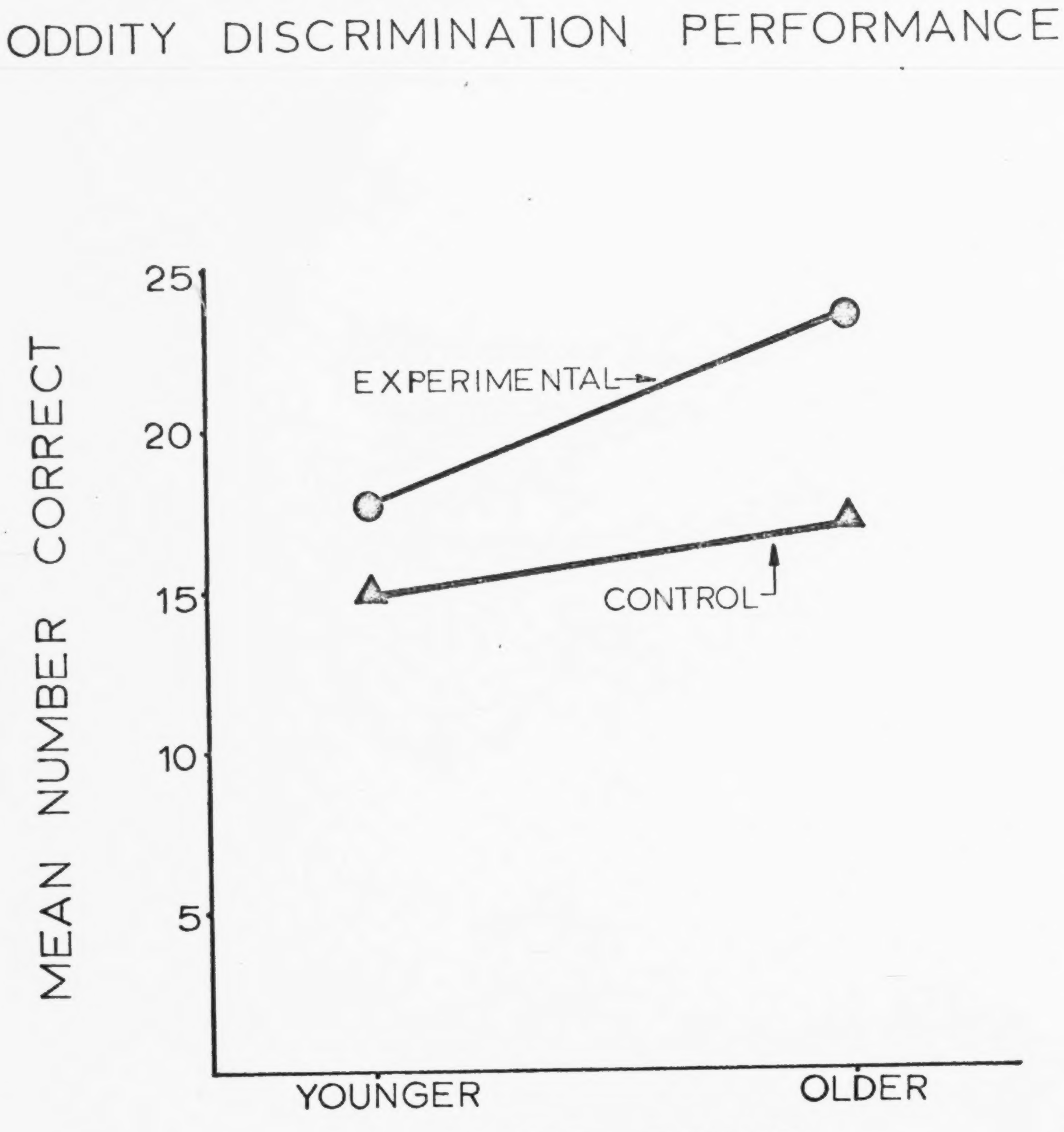
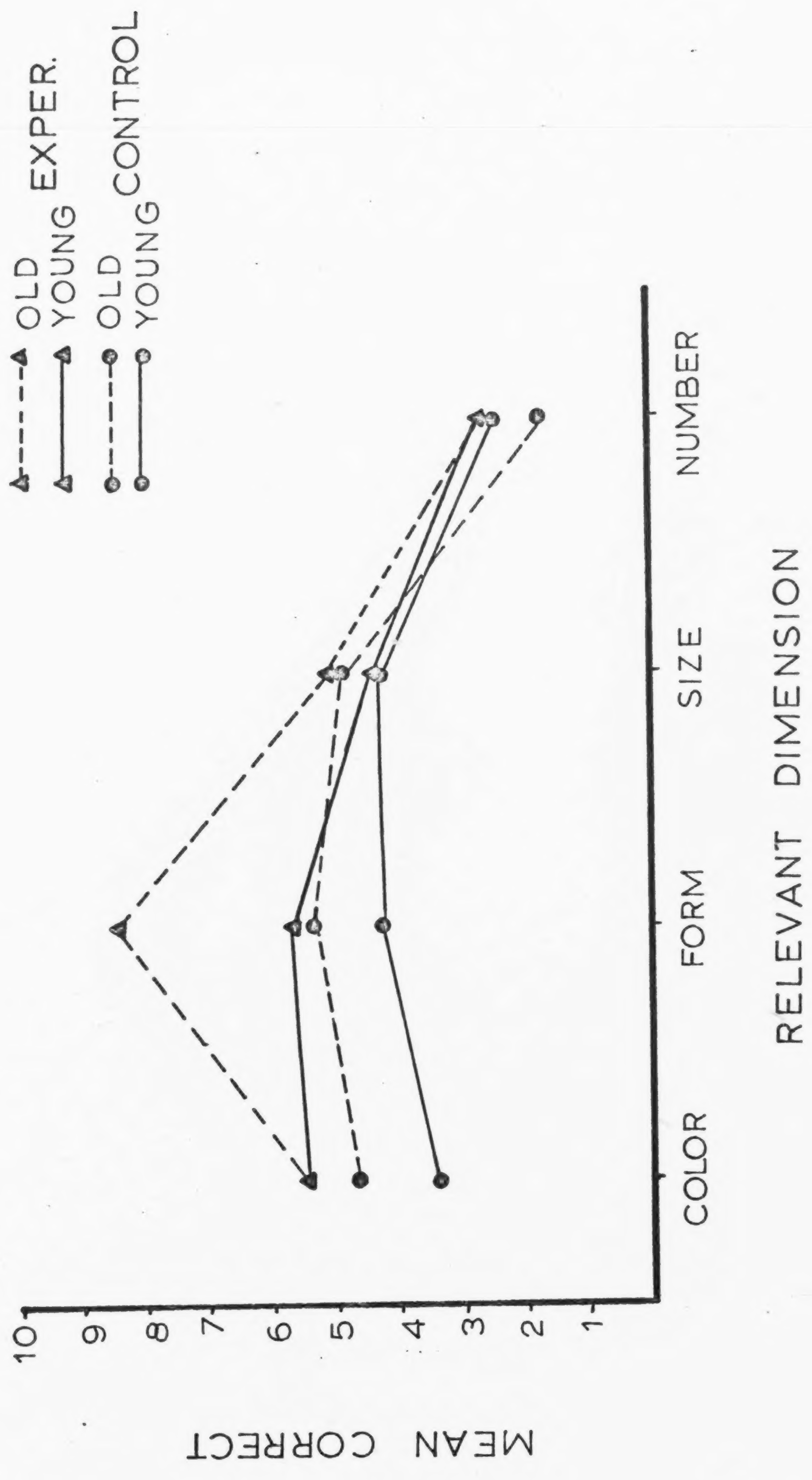

ODDITY DISCRIMINATION PERFORMANCE
MEAN NUMBER CORRECT
25
20
15
10
5
EXPERIMENTAL
CONTROL
YOUNGER
OLDER
AGE GROUP

Figure 20



I: ODDITY DISCRIMINATION PERFORMANCE BY RELEVANT DIMENSION

Figure 21

The response behavior of the control group was in many cases nonsystematic and non-enthusiastic, with a marked tendency to choose the middle stimulus as the odd stimulus. This particular study extended downward the age for the successful performance of an oddity discrimination, and supported the notion that success on such a task is highly related to level of intellectual development.

This past year we replicated the oddity discrimination paradigm with a revision of a number of the items (to reduce ambiguity) and expanded the number of items in the task. Otherwise the procedure was the same.

The mean number of correct responses for each group is shown in Figure 22. The performance of the experimental group is significantly superior ($p < .01$) to the control group, and although older children are significantly superior to younger children, it is the performance of the older experimentals which carries this difference. The younger experimentals are even slightly superior to the older controls.

This performance replicates last year's study and unfortunately, because of substantial changes in content and presentation of the stimulus material, no direct comparison can be made either between or within groups. Only the relative performance between groups and between categories is possible. In this case, the overall results are followed by the individual group performances in the subsections. On each of the relevant dimension sets, the experimental group is significantly superior to the control group (color and form are $p < .01$; size and number are $p < .10$). As in last year's data the form subsections are performed best, particularly by the older experimentals (now about five and one-half years). For the most part the younger experimental and the older control groups are comparable, with the young control group showing the worst performance. Whereas in last year's study, the number category was hardest, this year it appears at least as easy as the size-relevant dimension (see Figure 23).

The suggestion (Lipsitt and Serunion, 1963) that there is a relative chronological age level for performance on the oddity discrimination requires considerable investigation. Each age group downward must also consider general motivational factors and other variables related to development, viz., IQ and SES.

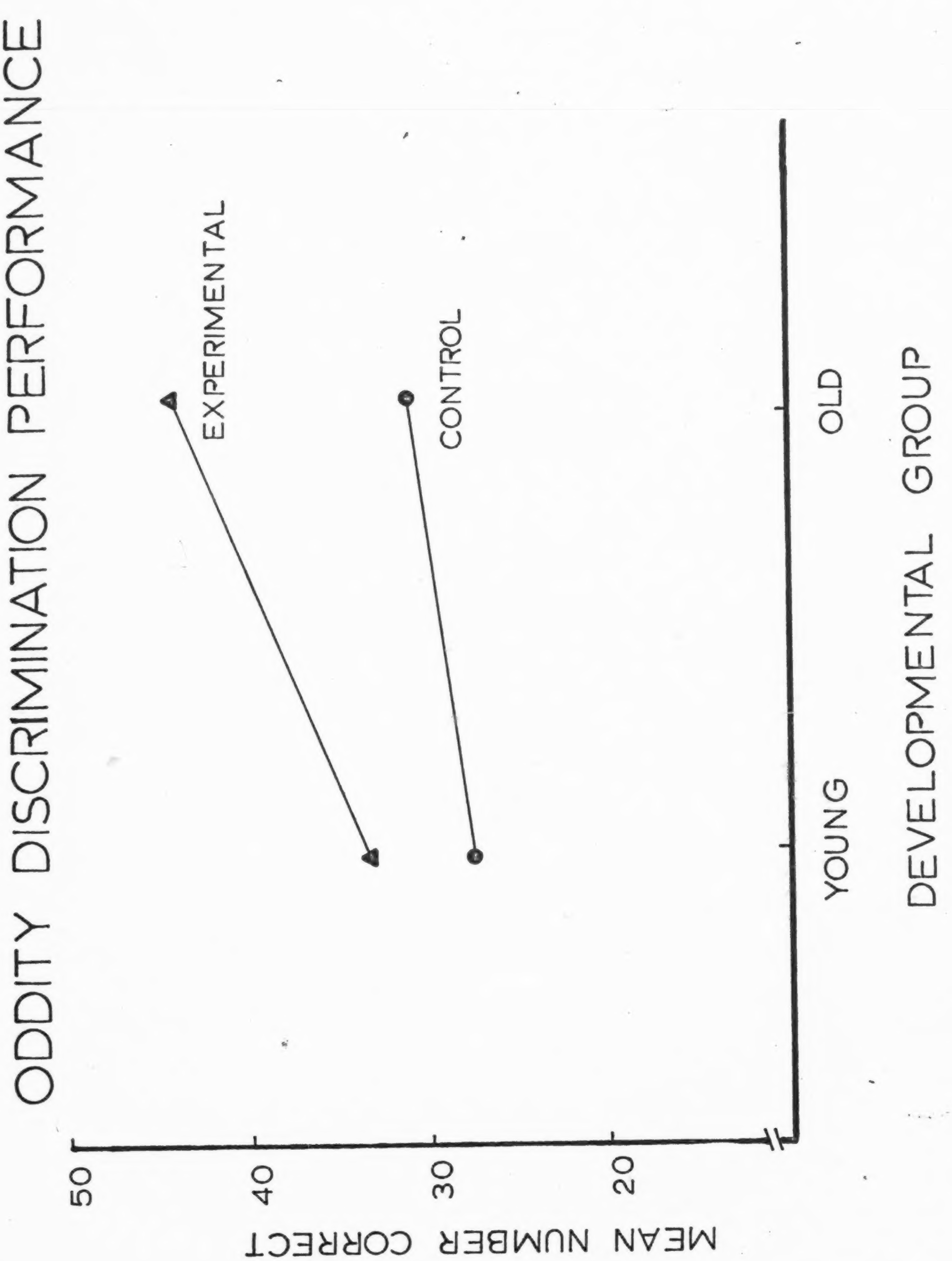

ODDITY DISCRIMINATION PERFORMANCE
EXPERIMENTAL
CONTROL
MEAN NUMBER CORRECT
50
40
30
20
YOUNG
OLD
DEVELOPMENTAL GROUP

Figure 22

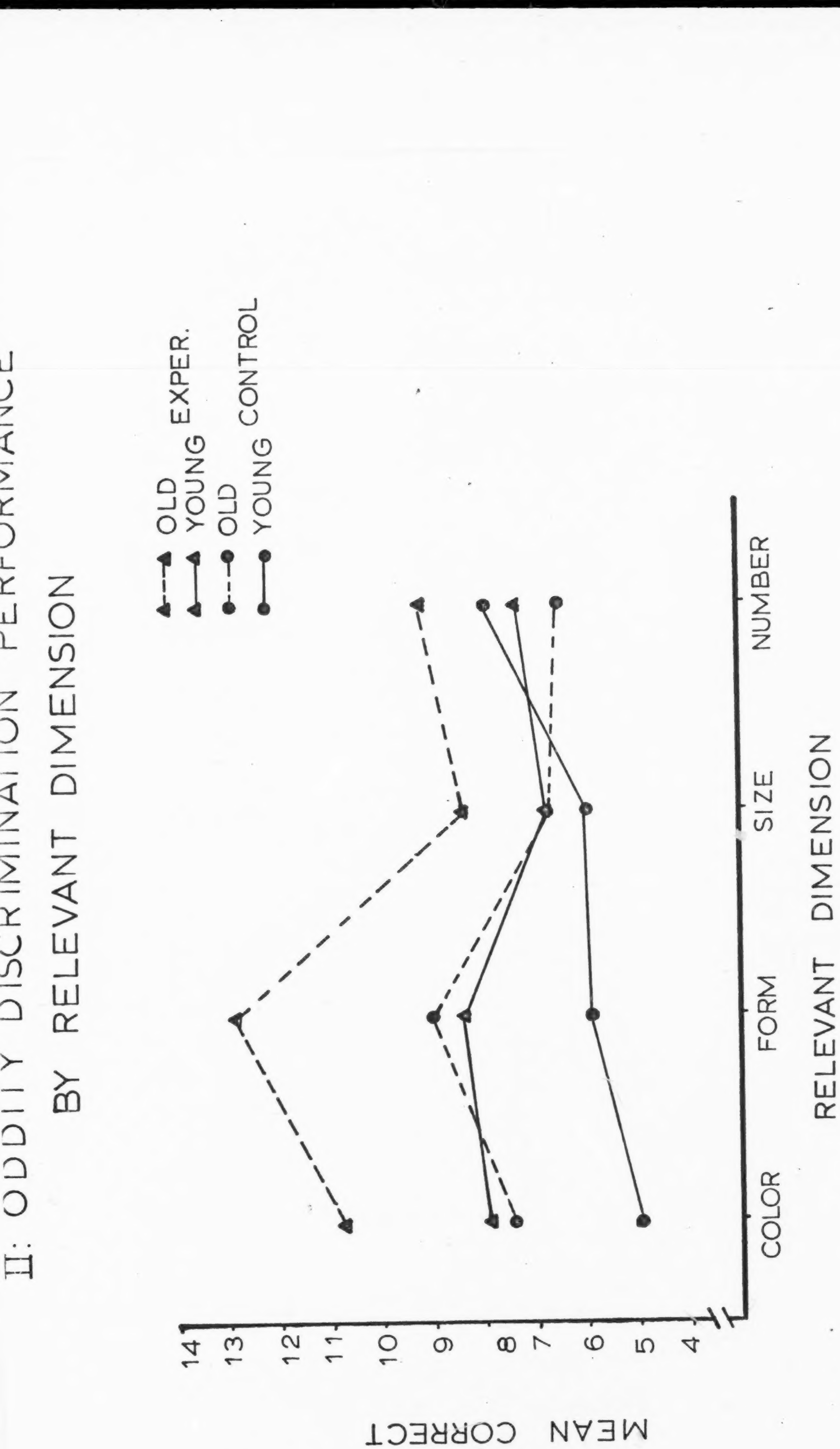

II: ODDITY DISCRIMINATION PERFORMANCE
BY RELEVANT DIMENSION
OLD
YOUNG
EXPER.
OLD
YOUNG
CONTROL
MEAN CORRECT
14
13
12
11
10
9
8
7
6
5
4
COLOR
FORM
SIZE
NUMBER
RELEVANT DIMENSION
136

Figure 23

In addition, as we have already pointed out, there is the major factor of dimension preference. There is considerable empirical evidence to the effect that in other types of learning tasks, where the dimension relevant to problem solution is also the subject's preferred dimension, rate of learning will be facilitated (Suchman and Trabasso, 1966). If the subject's preferred dimension is irrelevant to problem solution, this will interfere with acquisition, as the subject will tend to focus on a preferred, but irrelevant, cue.

Both experimental and control groups have previously been administered a color-form preference task. The results showed a definite tendency in the most recent study for the experimentals to prefer form. Obviously this preference can facilitate the performance of the experimentals and it is just this point that underscores our earlier remark regarding the development of attentional processes. Though it may be that dimensional preferences lead in some situations to response biases, it is also an index of the developmental process of selective organization of the stimulus environment. The earlier that such behavior occurs, the greater the facilitation of learning performance on just such kind of tasks. In experimental paradigms which attempt to manipulate attentional processes and yet either disregard or assume response biases due to dimensional preferences are under control, introduce an artifact in their results such that any performance difference between experimental groups may be spurious. In our case, the data points obviously to the facilitation of performance as a function of the degree to which early dimensional preferences have been established. In other words, what is taken to be a major methodological flaw in some studies can actually be taken as an additional variable facilitating or contributing to differential developmental performance.

It appears then, that although oddity discrimination performance is influenced by chronological age, this is true only in part. Rather, a major influencing variable of the performance of preschool age children--as it appears from these results--is the level of intellectual development and the concomitantly developing response tendencies related to perceptual development. Further, the rate of solution in this kind of problem, as it must in all discrimination situations, varies not only as a function of stimulus factors inherent in the test situation, but the response tendencies which accompany each subject to the test situation.

Use of the Ivanov-Smolensky Procedure to Index Differential Development

As we have noted several times, researchers are confronted by a two-fold problem when attempting to assess the development of young children. One part of the problem has been the availability of sensitive and reliable instruments for assessing early cognitive development. This is due to the fact that young children, especially those less than five years of age, are neither patient enough nor do they have the verbal facility to cope with anything but the simplest of tasks. Such tasks are superficial and are usually not predictive of a child's intellectual performance. The second part of the problem relates to the nature of the young child as a subject. Young children tend to respond more as a function of some response biases than as a function of the meaning of the stimulus problem. For example, there are color-form preferences, position preferences, idiosyncratic response strategies, etd. The consequence of this problem is that a child's response may not be indicative of his cognitive development but merely a behavioral artifact.

An early reliable assessment of cognitive development is particularly important for the identification of deficits which may be remediable with early intervention. An example in which the early identification of delayed cognitive development might be critical is suggested by recent evidence reported by Heber (Heber, Dever and Conry, 1968). He found that certain groups of disadvantaged children, particularly those whose mothers have an IQ of 75 or below, from the age of three show a slow but steady decline from a normal IQ to the retarded level of their mothers. Early detection could, in this case, lead to early intervention, which might help to mitigate whatever depressing effects are involved in this intellectual decline.

Thus, the problem that remains is one of trying to index the cognitive development of children less than four years of age. We have been working with such a group of very young children. In order to circumvent some of the problems of research with this population and still measure the differential development of two groups of young children, we attempted the use of a technique employed extensively by Luria (e.g., 1963) and other Russian workers. This technique, called the Ivanov-Smolensky procedure, does not bind the child either to single designative or recognition responses but still allows for a demonstration of differential cognitive development. The procedure requires merely that a child respond to simple verbal commands and colored lights by squeezing a rubber bulb. It was expressly developed for assessing development in young children with limited verbal skills and minimizes some of the research problems associated with young children. Russian researchers report having considerable success with its use, although replication attempts in this country have not been entirely supportive (e.g., Jarvis, 1968).

According to the Luria schema, there are developmentally related differences in the ability to regulate motor responses elaborated to certain verbal commands. These differences are manifested as response patterns which are peculiar to different levels in the developmental sequence, varying as a function of age and/or the intellectual development of the child. Our intention in this study was therefore to investigate this technique, in a well-controlled and well-instrumented procedure, in an effort to develop the Luria, Ivanov-Smolensky procedure as a clinical device for the assessment of cognitive development.

Our population of children participating in the project was uniquely suited to a test of the Luria notions. The experimental group, on the basis of their (standardized test) IQ scores, were developmentally in advance of a comparison group of non-stimulated control children. From this population, four groups of children, varying in age and IQ, were formed to test the sensitivity of the Ivanov-Smolensky procedure and to detect differential development. The design was a 2 x 2 factorial design. The children were divided, as before, into Low and High age groups (30 and 40 months, respectively). The design of the study thereby provided a basis for testing Luria's notions regarding the differential development of regulatory control, both as a function of age and intellectual development. It was expected that if the Ivanov-Smolensky procedure was sensitive to differential development, superior performance would be shown in the form of an increase in regulatory control with increased levels of development.

Apparatus: A modified Ivanov-Smolensky procedure was used. Each child was shown a series of red and blue lights, displayed through a milk-glass screen. The manipulandum was a rubber bulb, connected by way of a pressure transducer to a polygraph. Each response made by a subject was recorded automatically and provided a record of the response onset, duration and amplitude. All stimulus presentations and interval times were controlled by instrumentation.

Procedure: Each child was seated in front of the display screen and his hand placed on the rubber bulb. Then each subject was simply told to listen to what the experimenter said. The experimenter waited approximately three seconds after stimulus onset before giving the verbal command. The command "SQUEEZE" was given if the stimulus was positive (S^d) or "DON'T SQUEEZE" if the stimulus was negative (S^Δ). A series of tasks was given to each subject including a preliminary Acquisition Task (S^d only), followed by a Discrimination Task (S^d and S^Δ); a Reversal Task (S^d and S^Δ reversed); and an Extinction Task (same as Reversal, but no reinforcement).

Results and Discussion

The frequency of response data for each of the four tasks was submitted to an analysis of variance. There were two sets of data: (1) frequency of responses correctly made; and (2) frequency of responses correctly inhibited. The analyses of variance revealed significant effects only for frequency of responses correctly made, and only for the Acquisition Task (see Figure 24). In this case older children were superior to younger children ($p < .01$) and High IQ children were superior to Low IQ children ($p < .01$). A significant ($p < .05$) interaction effect revealed that both High IQ groups were superior to either of the Low IQ groups. The fact that only Acquisition Task showed differential performance effects and only for the ability to respond correctly suggested one or both of two things: (1) that the Acquisition procedure had not been extended sufficiently in the early tasks; and/or (2) that the inhibitory process is inadequately developed at these early ages.

The second set of data submitted for analysis to a multivariate analysis of variance* consisted of the intensive measures (response onset, duration and amplitude) for both correct responses and incorrect responses. Only the response amplitude data for correct responses showed consistent significant differences between

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*The data was submitted for analysis to a multivariate analysis of variance computer program. The program has among its many options the provision for unequal numbers of observations in subclasses. Further, an analysis phase provided for analysis of selected subsets of variables from the original input set. The computer program is titled "FINNVER 4" (Finn, Version 4) by the University of Wisconsin Computing Center, and is the program mainly developed by Jeremy D. Finn of the Department of Educational Psychology, The State University of New York at Buffalo.

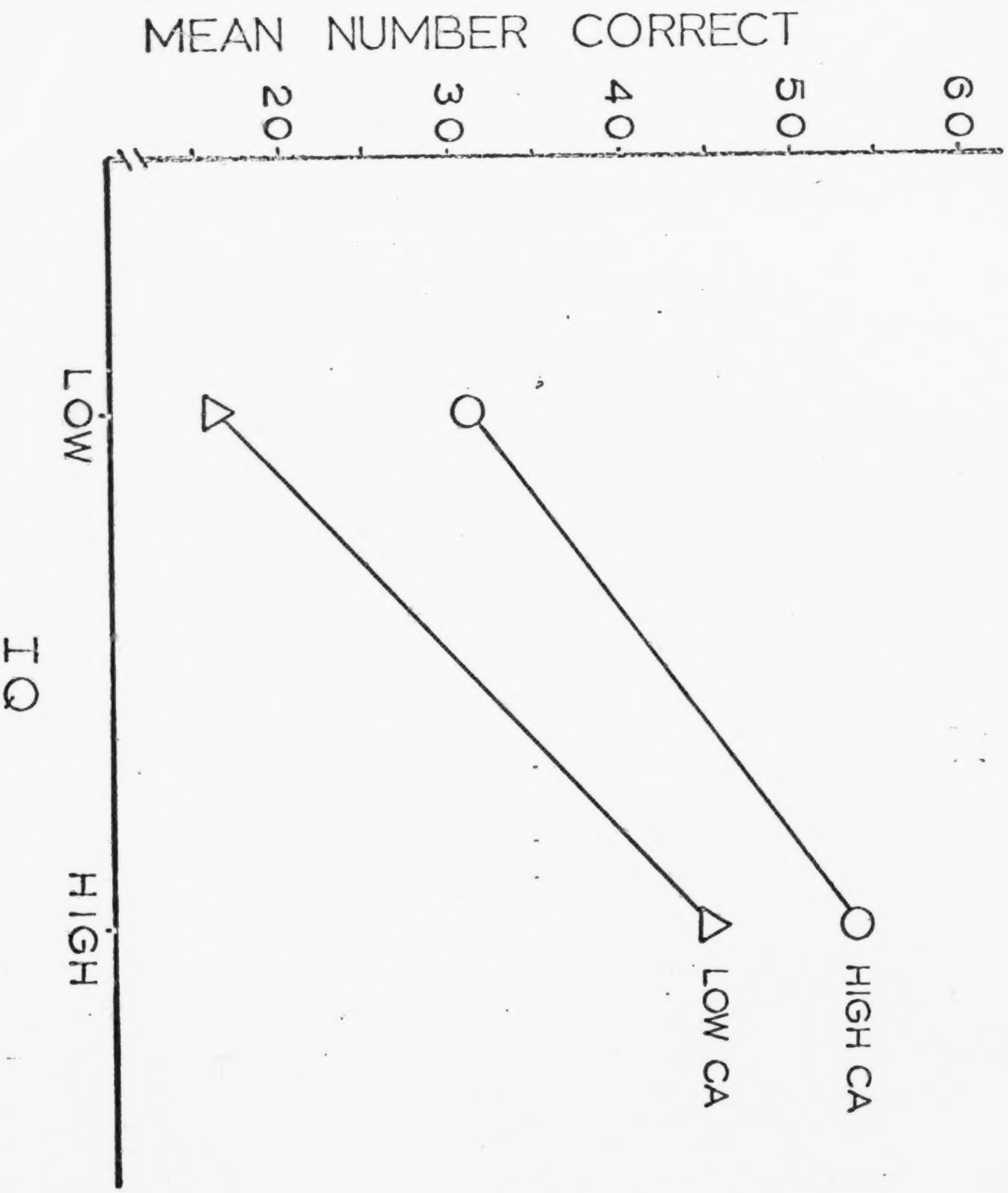


Figure 24

the groups. The significantly ($p < .001$) greater response amplitudes made by the older children is consistent with earlier research (e.g., Birch, 1966) (see Figure 25). However, this finding is easily attributable to sheer physical differences and is not a satisfactory test of the Luria hypothesis. On the other hand, a major finding was the significantly ($p < .005$) lower amplitude by the High IQ group (see Figure 26). In this case, since physical differences are minimized, the finding of lower response amplitude can be taken as an indication of an increase in response economy with increasing intellectual development, which is consistent with the Luria hypothesis.

The Ivanov-Smolensky procedure has been replicated and is in the process of being analyzed. The procedure underwent modification this year. One of the changes was requiring a criterion in pretraining. This may have resulted in hastening this task time and thereby minimized transfer to the discrimination task and short-cut warm-up time necessary for stabilizing motor performance.

In addition, a new scoring technique and measure has been developed for use with this task. By using a planimeter, a measure results which is actually a derivation of the amplitude and duration measures combined. As yet the data is not analyzed so any comment on the sensitivity of this technique would be premature.

In summary, it was felt that, on the basis of an initial study, the Ivanov-Smolensky procedure was a promising research device. If it is to be used as an early screening device, the sensitivity of the technique must be increased. This probably can be accomplished by applying it to a wider range of populations varying in intellectual development.

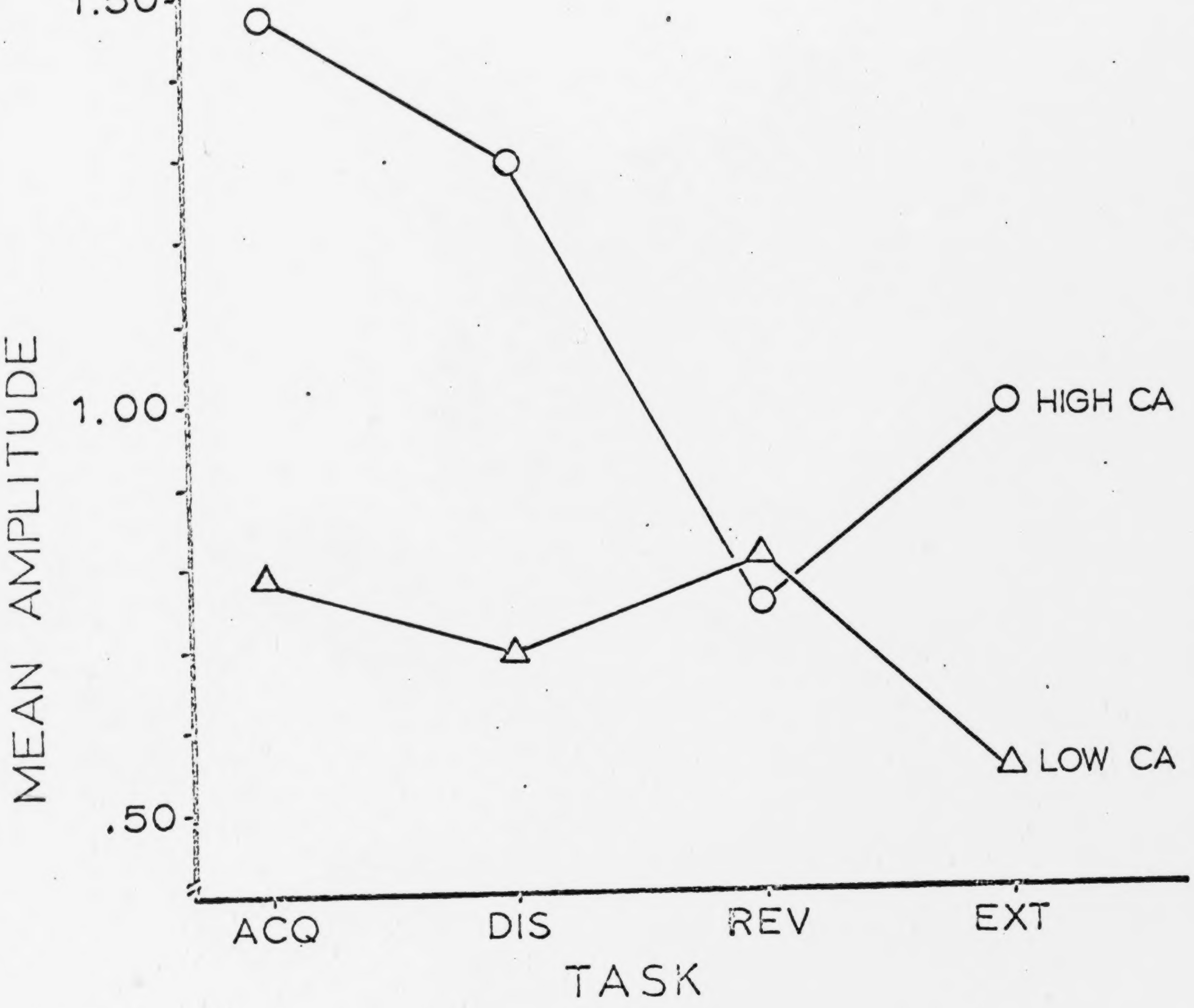


Figure 25

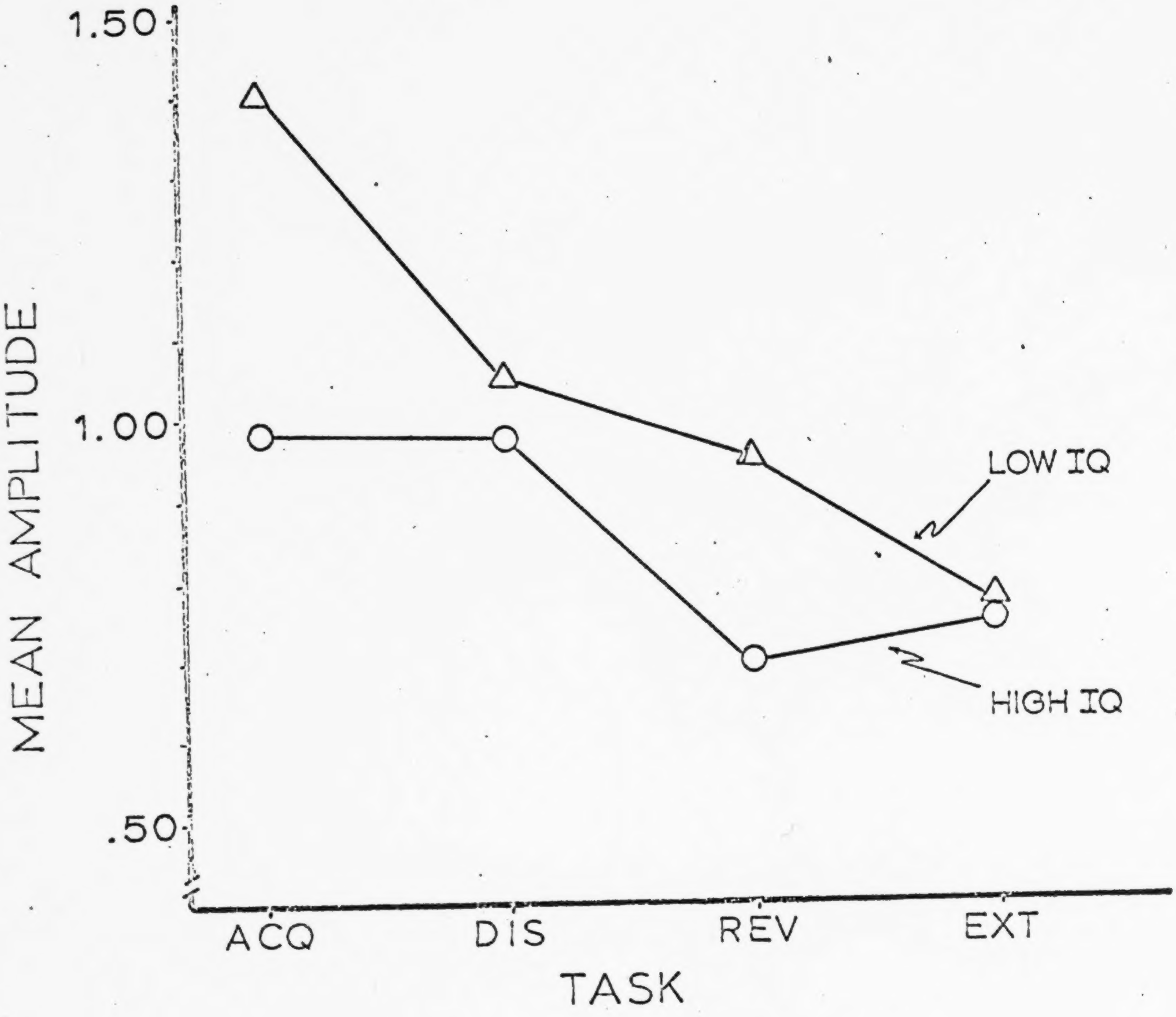


Figure 26

CHANGES IN AMPLITUDE PERFORMANCE BY IQ GROUP

APPENDIX

SUMMARY OF FINDINGS FROM ANALYSES OF ALL DATA

I. Frequency of responses correctly made:

Acquisition: High CA superior to Low CA
High IQ superior to Low IQ
High IQ, High and Low CA superior to Low IQ, High and Low CA

Discriminations)
Reversal) No significant sources of variance
Extinction)

II. Frequency of responses correctly inhibited:

Acquisition)
Discrimination) No significant sources of variance
Reversal)
Extinction)

III. Intensive properties of correct responses:

A. Response Time:
Unordered increase in extinction for all groups
B. Duration:
No significant sources of variance
C. Amplitude:
High CA showed greater amplitude than Low CA
High IQ showed lower amplitudes than Low CA

IV. Intensive properties of incorrect responses:

A. Response Time:
High CA responded slower in Extinction than Low CA
B. Duration:
No significant sources of variance
C. Amplitude:
No significant sources of variance

Conservation in Young Children as a Function of Level of Intellectual Growth

Developmental research has benefitted considerably from the contribution of Piaget (e.g., Flavell, 1963). Within the epistemological framework of stage development which he sets forth, the "schema of conservation" has generated a great deal of attention; perhaps because it reflects the earliest point in complex cognitive ability and moreover because the age of onset can be an index of intellectual growth. Conservation is the cognitive ability which allows an individual to hold a particular dimension of an object conceptually constant even though other irrelevant aspects of the situation may be altered (Wohlwill and Low, 1962). According to Piaget, younger children do not show conservation because they are unable to conform to operational structures of logical thought. In other words, the non-conserving child fails to conceptualize the constancy dimension of an object when other features of that object are altered.

Little is yet known about the transition from lack of conservation to the presence of conservation in young children's cognitive growth. Studies which have been concerned with this aspect of children's thought have exposed children slightly below the age of onset of conservation to variables assumed to be important for acquisition of conservation (Goldschmid, 1967; Goodnow and Bethen, 1966; Siegel and Goldstein, 1969; Goldschmid, 1968). Among these variables has been the possible effects of training experiences upon age of onset of conservation. Mermilstein and Schulman (1967), for example, reported that non-schooling had no significant effect upon the age of onset of conservation. They did, however, find differences in performance on verbal and non-verbal tasks. This finding assumes particular importance in dealing with young children whose verbal facility is usually limited. Since conservation is inferred from the child's use of referential words like "more," "same," and "less," it thus becomes not only a study of logical operations but also a study of the child's ability to understand the vocabulary of conservation. The findings of Griffith, et al. (1967) support this in reporting differential ability of pre-school children to use the three referential terms, "more," "same," and less." Young children in general have more difficulty using the term "same" correctly.

The question of training effects is far from resolved. For every study reporting little effect of training (Mermelstein and Meyer, 1969), there are others which report significant transfer of training effects (e.g., Rothenberg and Orost, 1969; Gruen, 1965). A recent review of studies concerned with training of conservation skills (Shantz and Siegel, 1967) generally concluded that there appeared to be a variety of factors resulting in conservation. Unfortunately, there is considerable inconsistency in the adequacy of the training procedures between studies. Kingsley and Hall (1967) and Towler (1968) have suggested that a large number of training failures result from the refusal to recognize the amount of background or experience that is necessary and therefore the longer time needed to train young children for conservation mastery.

Inherent to the question of training effects is another important issue for Piagetian theory: how to identify the type and amount of experience necessary for growth of logical thought. As Siegel and Hooper (1968) point out, Piaget views the environment as playing a facilitating role by providing the necessary stimulation. Due to the concern for researching the general development of intellect, little research effort as yet has been directed toward investigating the influence of the environment on the growth of cognitive structures. Piaget does not delineate the environmental forces which may influence _transition from stage to stage_. Piaget rather described the development of logical reasoning as a process of covert _organization_ of reality.

Consistent with the increased concern for environmental influences on intellectual growth, most recent studies consequently centralize on the question of environmental differences. Rothenberg and Courtney (1969), for example, were interested in conservation of young children of different socioeconomic status, in view of the environmental differences which accompany them. In addition to the conventional age differences found in most studies on conservation, they also report significant socioeconomic differences in conservation attainment. The increases from lower to middle class subjects as well as from younger (2-5 yrs.) to older subjects (4-4 yrs.) suggest, moreover, that there exists a gap as early as 2-5 years to 4 years in conservation ability. This should be considered particularly in reference to the language aspect of conservation. Since most conservation studies with children younger than four years have been limited to middle SES children, it is difficult to corroborate these findings. If, however, they are generalizable to other cognitive areas, there may exist a serious cognitive deficit in lower SES children as young as 2-5 to 3 years. This would tend to support

Bayley (1965) who has postulated that mental functioning differences in low SES children are existent within the second year of life even though they are not often discovered until four years and older.

Age of onset of conservation has not been substantiated by investigators, even though Piaget ascribes it to be around six years (Piaget, 1952), depending on the type of conservation. On the other hand, recent studies (Mehler and Bever, 1967; Bruner, 1966) suggest that conservation of quantity may be present by age four to five. Mehler and Bever (1967), for example, report that children from two years six months (2-6) to three years two months (3-2) acquire conservation of quantity which they lose as they get older and re-acquire at about age 4-6 years. However, obvious limitations are evident in their methodology. Mehler and Bever presented two rows of either clay pellets or M & M's and asked the subject to judge whether they were equal. The rows were not equal in quantity, and consequently the tasks do not represent a true conservation experiment. In other words, the quantity (number of pellets) between the rows was not held constant as the space between the pellets was altered. In effect, the experiment represents only perceptual recognition. The significant findings nevertheless led Achenbach (1969) to conduct a replication study which did not reveal similar findings and implied rather that if error factors are controlled, subjects do not demonstrate correct responses significantly different from the chance level of 50% for the binary choice offered them.

Another attempt to replicate the earlier findings of Mehler and Bever by Rothenberg and Courtney (1968) reported that the former experimenters had used a single biased question to estimate conservation. Rothenberg and Courtney differed slightly in their procedure by placing only horizontal orientations of the rows of M & M's before the subjects, whereas Mehler and Bever report that horizontal and vertical orientations as well as nearness of the longer row were systematically varied. More than likely, as Gruen (1966) points out, the differences in conservation attainment reflect differences in criteria for attainment (Gruen, 1966).

We were concerned with the differential ability and attainment of conservation of number in very young children of low socioeconomic status. Based upon the method of Rothenberg and Courtney (1969) which represents a less biased and more complete way of testing conservation in young children, the effect of social class, age, and sex on conservation of number could be investigated. The suggestion that cognitive deficits exist in lower SES children might be a function of the environmental situation. Therefore, as environmental stimulation is varied for two groups of low SES children in the following conservation study, it might be expected to result in a differential contribution to the child's performance on the conservation of number task. The primary purpose of the study then was to determine whether low socioeconomic status can be compensated for by extra environmental stimulation and whether that stimulation affects the age of onset of conservation of number.

Method

Subjects: The subjects (Ss) in the experiment were the experimental group participating in the daily program and the control group, which does not participate in this stimulation program but which is tested periodically.

Apparatus: A set of eighteen wooden blocks (1-3/4" x 1-3/4" x 1-3/4") uniform in color, size and shape is utilized in the actual task. In addition, a table and two chairs are required for the experimenter (E) and S.

Procedure: The Ss were tested individually. The ability to understand the necessary language (more, same and less) was assessed first through presentation of some introductory items. An initial non-conservation practice item was performed in which two rows of five blocks each were constructed, one by the E and one by S. Subsequently, one block was removed from each row and questions concerning "same," "more" and "less" were asked. Although no conservation was required of the S, the task allows E an estimation of how well the S understood the language of the task.

Two similar questions are asked in each of the transformations as described by Rothenberg and Courtney (1969). This allows for a more reliable estimate of the S's understanding of the problem. The questions include: "Does this row have the same number of blocks as this row?" and, "Does one row have more blocks than the other one?" Following the responses to these questions, the Ss are asked why they are the same if they responded correctly and exhibited conservation. If they do not respond correctly in reporting conservation, they are asked which row has more blocks and why.

Five transformations were presented, each of which were concerned with conservation of number:

1) Collapsing - five blocks are placed in each of the two rows with equal spacing between them. After establishing from the S that each of the two rows is equal, one row is displaced inward such that the blocks are more bunched up.

2) Rotation - five blocks are again placed at equal distances within two rows. The S is again asked to verify the equality of the initial construction. One row is then rotated to a 90 angle still maintaining the same distance spacing between the blocks.

3) Expansion - two rows of nine blocks are set up with the subsequent elongation of one row through increasing the space between blocks.

4) Equal addition - after two rows of three blocks each are initially viewed as being equal by the S, one block is added to the end of one row, and another is added within the other row.

5) Unequal addition - after two rows of three blocks each are initially perceived as equal by the S, one block is added to one row and two blocks are added to the other row.

Scoring: An S is able to obtain a score of either 0, 1 or 2 on each task. If the S responds correctly to the two questions (same, more), as well as "which side has more?" for No. 5, he receives a score of two and is classified as a conserver (C). Ss who answer incorrectly, i.e., do not exhibit conservation, but who are nevertheless consistent in their answers (e.g., "no" to the first question of sameness and "yes" to the second question of one row having more) are classified as consistent non-conservers (CNC) and receive a score of one. Ss who are neither correct nor consistent in their manner of answering (e.g., "yes" to both questions) are classified as inconsistent non-conservers (INC) and receive zero points. A perfect total score for the five transformations indicating conservation of number mastery would thus be 10, while the total score range is from zero to 10.

The question concerned with justification, which is asked after the first two questions in each of the five tasks, is not included in the total scoring procedure but is used as a verbal measure. Nine types of responses as described in Rothenberg and Orost (1969) are listed in order from most to least acceptable: numerical, transformational, matching, descriptive, perceptual, limited verbal, don't know, magical, and no response. Only the first three are considered adequate as conservation explanations. Differences in verbal adequacy of response will be compared to overall conservation ability as well as to group differences which include age and experimental vs. control Ss of the longitudinal study. These will be expressed in terms of percentages of reason levels of the above variables.

A preliminary analysis has been completed on the results of the conservation of number task. For the most part, conservation is only partially demonstrated in any of the groups. However, we chose to accept performance to a criterion as an index of the prototype of conservation behavior. On this basis we considered the number of Ss which had achieved at least five out of the 10 possible points as a demonstration of conservation. In this case, none of either the older or younger control children showed any tendency toward conservation, even with this liberal criterion (see Figure 27). On the other hand, 36% of the younger experimentals and 82% of the older experimentals showed conservation (by our criterion).

On the individual number tasks, the experimentals are superior on each as compared to the controls. The easiest number task appears to be the unequal addition, which is probably due to the perceptual cues provided by unequal length. The second easiest seems to be the equal addition, again for perhaps the same reason as in unequal addition. Performance data for these tasks are presented in Figure 28.

It would be premature to suggest that this is, in fact, conservation on the part of the experimentals. The literature does not supply enough information to judge whether our criterion is sufficiently stringent to permit proclaiming their behavior as demonstrating conservation. However, the performance of the Ss suggests that the tasks are not comparable and that facilitatory cues are available to the S. The possibility that performance in this task is sensitive to cues is evidenced by Rothenberg and Courtney's 1968 replication of the Mehler and

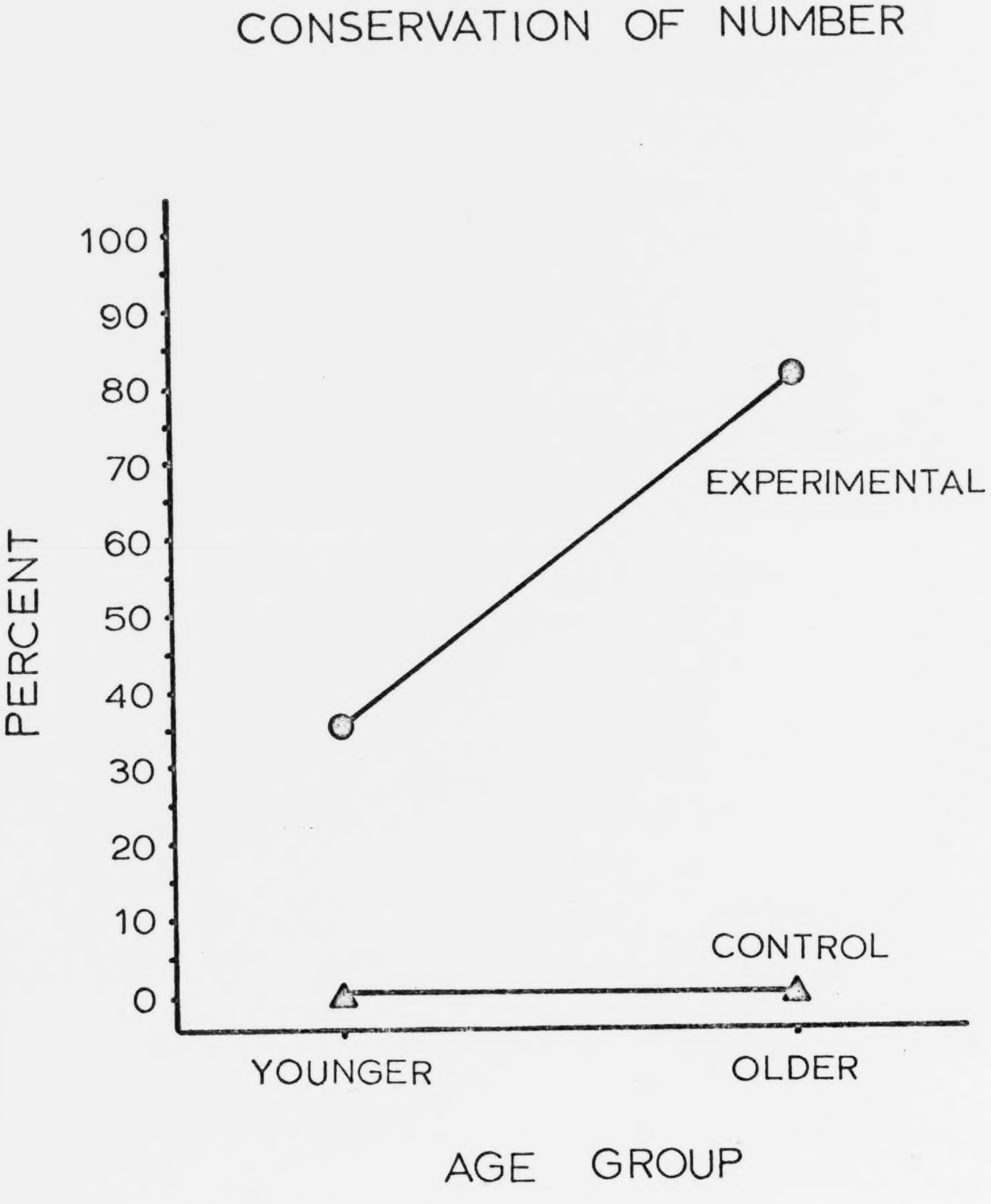

CONSERVATION OF NUMBER
100
90
80
70
60
50
40
30
20
10
0
PERCENT
EXPERIMENTAL
CONTROL
YOUNGER
OLDER
AGE GROUP

Figure 27

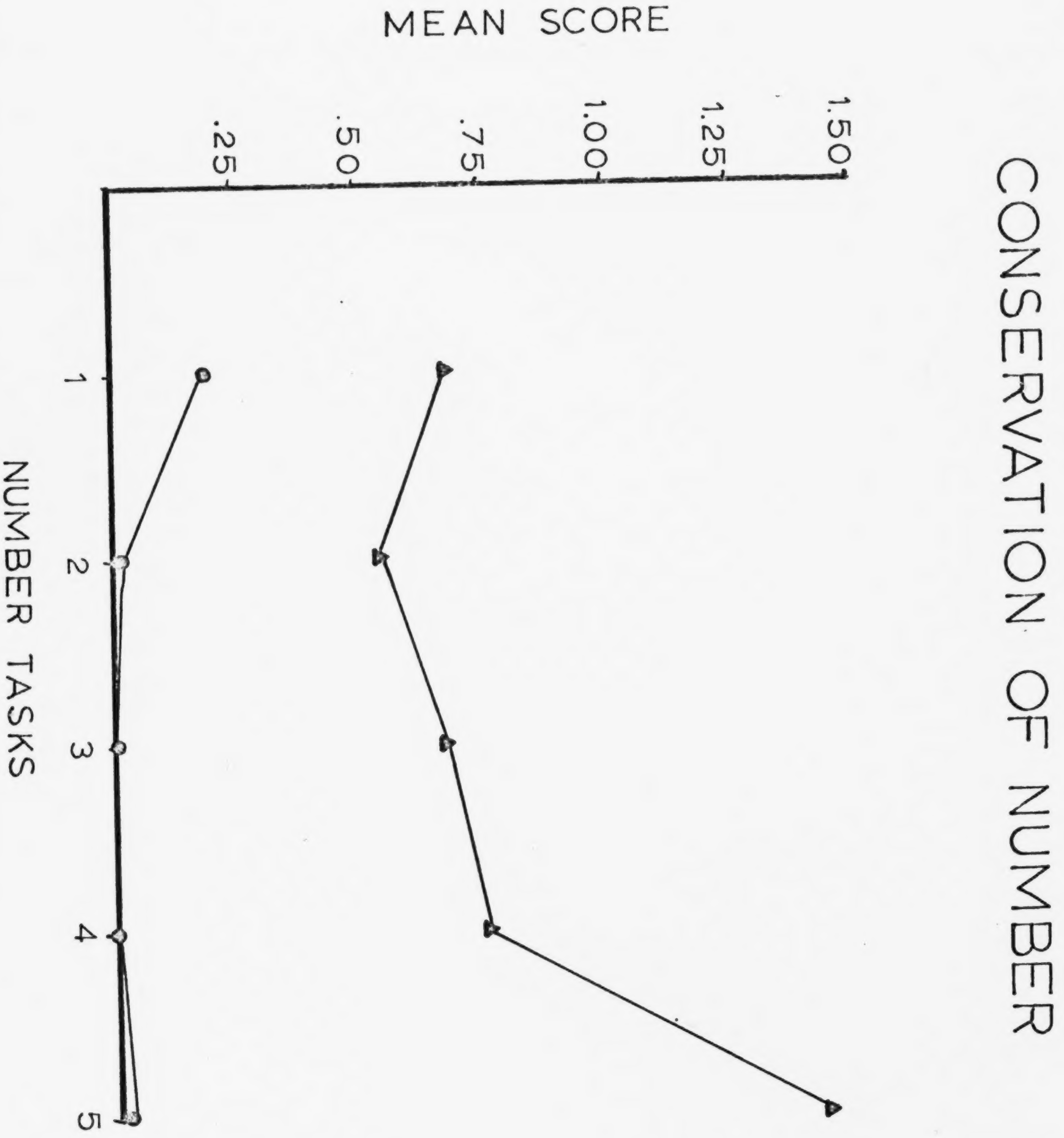

CONSERVATION OF NUMBER
MEAN SCORE
1.50
1.25
1.00
.75
.50
.25
1
2
3
4
5
NUMBER TASKS

Figure 28

Bever study (1967). The latter study reported performance of comparably aged children similar to that of our experimental children.

Conservation of Quantity in Young Children

The previous study provided an initial attempt at examining development along Piagetian lines. However, since conservation is thought to develop dimensionally as well as differentially, a single study cannot reveal complete information as to how low SES children attain conservation. The studies on quantity conservation permit further investigation of the cognitive skills of these young children. Critical factors again relate to age at which conservation is attained as well as the differential effects of training, i.e., extra environmental stimulation vs. no extra stimulation.

Quantity studies generally report a sequential rate of attainment; matter is the first quantity conserved, weight follows next, and volume seems to be the last conservation of quantity to develop (Flavell, 1963; Goldschmid, 1967). Piaget outlines roughly the age levels at which each quantity occurs: 8-10 years for mass, 10-12 years for weight, and 12+ years for volume (Inhelder and Piaget, 1958). On the other hand, some recent studies (Smith, 1968; Smedslund, 1961) suggest that conservation of quantity may be present as early as five and six years.

Essentially similar methodology to that of number conservation is employed to assess conservation of quantity. Clay is the medium instead of blocks, but analysis and scoring procedures are analogous to the previous study.

Instructions to Ss:

1) Here is some clay. You can see that we have two bunches of it (have the child examine the clay). I am going to make a ball with one bunch, and I want you to take the other bunch and make one that's the same as mine. Make it just like mine. Very good, (name). Now let's put them next to each other. See, they look the same, don't they. There's the same amount of clay in each ball.

2) Watch what I am going to do now. (Take one ball and roll it into a sausage shape.) Is this ball the same as the sausage? Does one have more clay? (Depending upon the answers), why are they the same (if conserving) or which has more clay? Why do you say that?

3) Let's make them into balls again. Are they the same now, (name)? This time I'm going to make one look like this (shape one ball into a pancake). Does this piece of clay have the same amount as this one? Does one piece have more clay? Which has more clay or why are they the same?

4) Let's make them into two balls again. Are they the same? Yes, (name), that's right--they are the same. There's the same amount of clay in each ball. If I take this ball and cut it into two pieces like this, does this clay have the same amount as this? (Is there just as much to eat?) Does one have more clay? Why are they the same (if conserving response) or which one has more clay? Why do you say that?

The results of the conservation of quantity task have only recently been analyzed. Again, as with conservation of number, conservation of quantity is only partly demonstrated. This of course is not unexpected, since this behavior is supposed to appear later than conservation of number. We chose to set a criterion for accepting performance as having indexed conservation of quantity for an S. On this basis we accepted four out of eight as a demonstration of conservation. In Figure 29 we have illustrated that none of the control children achieved this rather liberal criterion, while 27% of the younger experimentals and 82% of the older experimentals achieved at least four out of eight. The differences between the tasks are relatively unremarkable (see Figure 30). Moreover, the expected age for conservation of quantity of mass according to Piaget (Inhelder and Piaget, 1958) is 8-10 years, or even five or six according to some (e.g., Smith, 1968). Therefore, our results, especially with a liberal criterion, may or may not have tapped the prototype of conservation of quantity behavior.

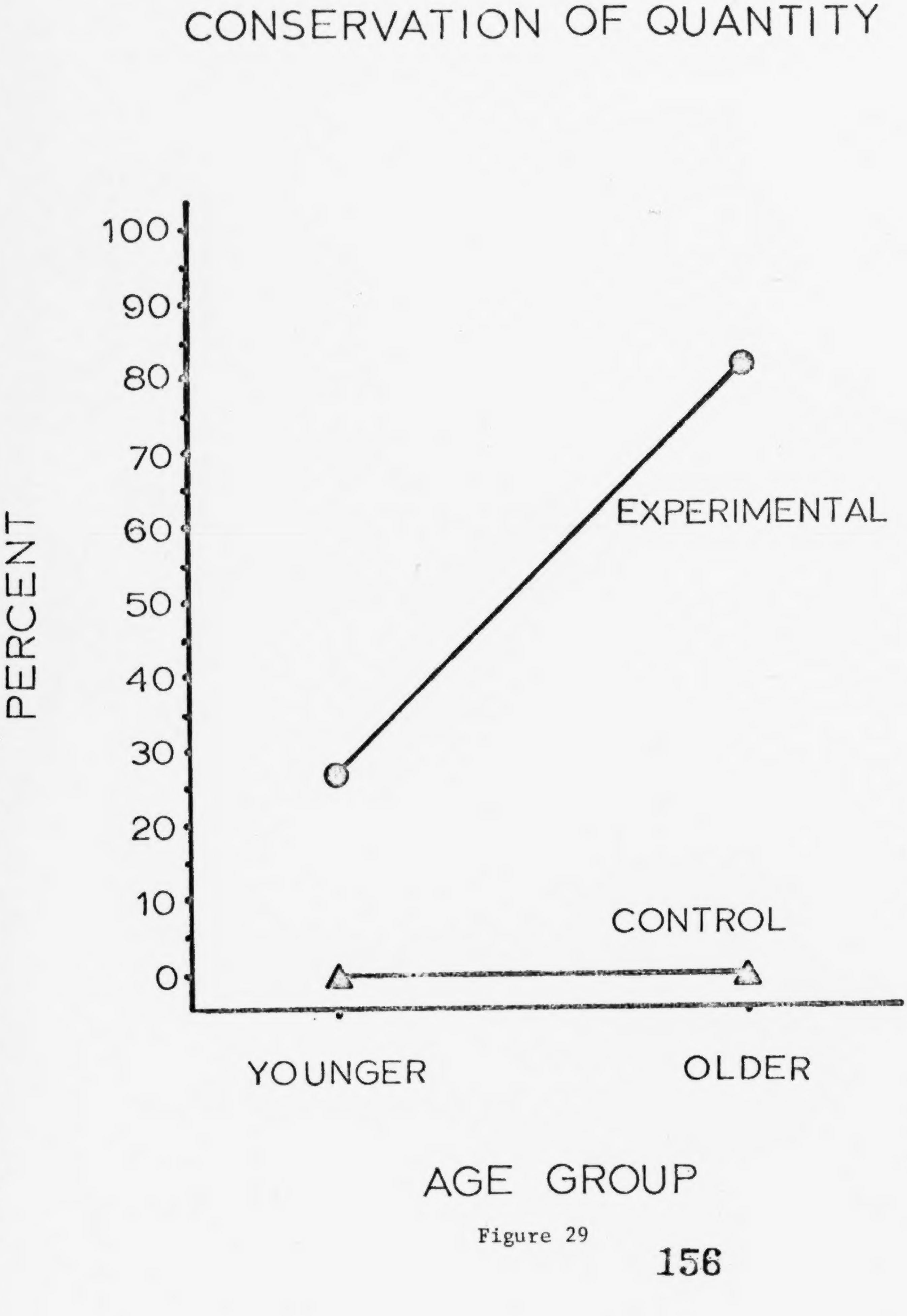

CONSERVATION OF QUANTITY
PERCENT
100
90
80
70
60
50
40
30
20
10
0
EXPERIMENTAL
CONTROL
YOUNGER
OLDER
AGE GROUP

Figure 29

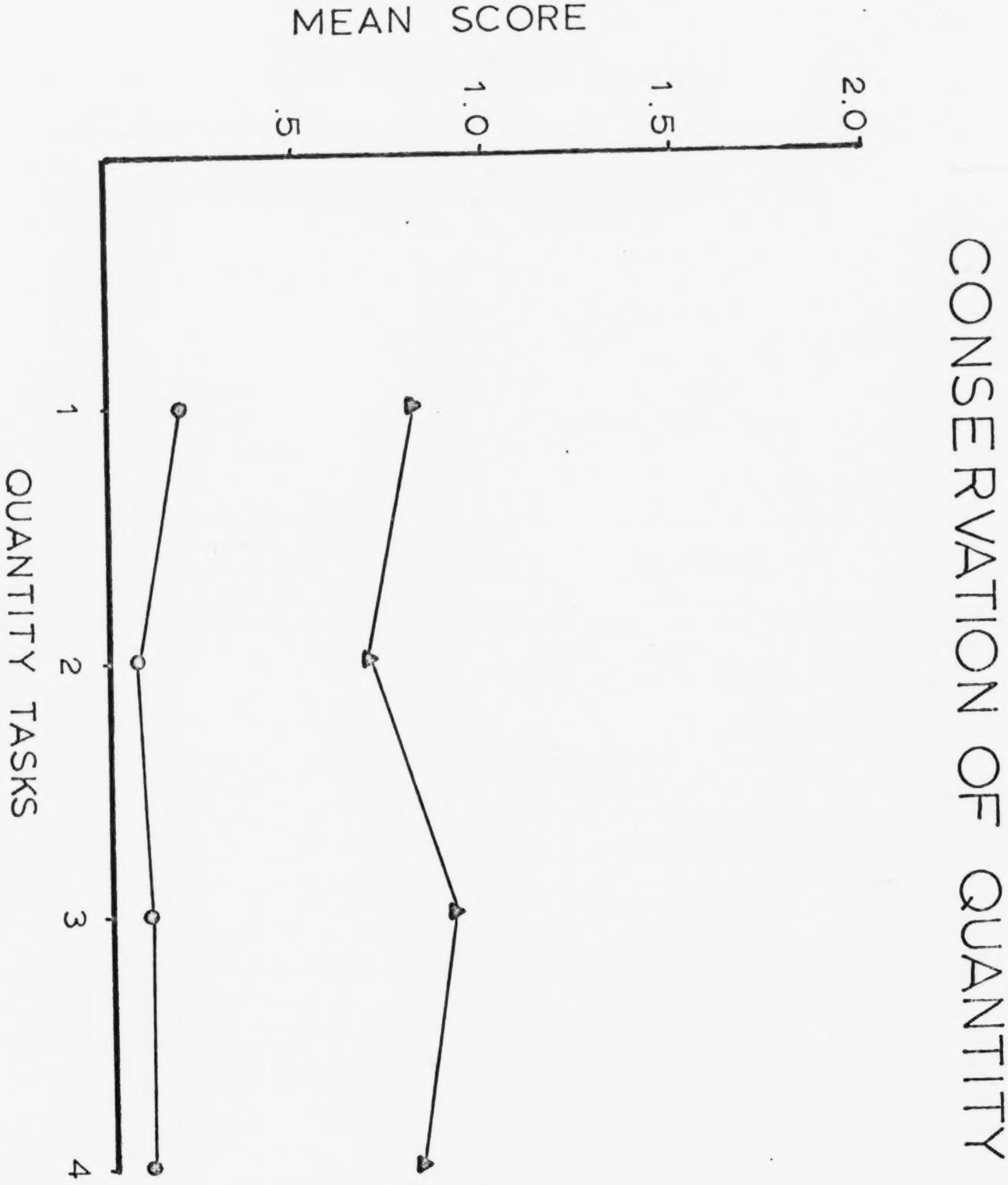

CONSERVATION OF QUANTITY
MEAN SCORE
2.0
1.5
1.0
.5
1
2
3
4
QUANTITY TASKS

Figure 30

Neither the evidence available from our research or in the literature is sufficient to confirm this. We shall replicate both studies within the coming year.

Assessment of Digit Span

The digit span task from the WISC intelligence test was administered to all the children in the project. Digit span has a long history of attempts to relate it to intelligence. It is included in the original Binet Scale and though criticized by Wechsler (1958) as a poor measure of general intelligence is still included in the WISC and other tests of general intelligence. Basic to the penchant for the use of the digit span test is the notion that memory ability is a fundamental difference between individuals of different intellect. Digit span is a measure of short-term memory, which is a critical mental ability that must be involved in every learning and problem-solving task. Indeed, the major theories used to account for differences between normal and retarded children emphasize short-term memory (e.g., Ellis, 1963).

Ellis' stimulus trace theory proposed that the physiological trace of memory is weaker and briefer in the retarded child. Moreover, it is a developmental factor in that the child increases his ability to maintain the trace as he grows older (and with increasing intelligence). However, Jensen (1969) hypothesizes that this is only true in "primary mental retardation." In secondary mental retardation, then, there is a deficit in Level II functioning: the abstract and conceptual processes. The majority of the low SES children are in the 50 to 85 IQ range and are intellectually retarded only in the secondary sense: there is no short-term memory deficit.

The correlation between digit span (DS) and IQ which is found in the "normative" population breaks down in low SES populations; this is the deficit in Level II mechanisms. There is too little variance in Level II potentials in low SES groups for large individual differences in Level I abilities to make a difference in Level II tests.

In a study comparing white middle class population to Negro Southerners, Kennedy, Van de Riet and White (1963) contrasted DS and IQ scores. The mean IQ for the Negro children was 80.7 and for the whites, 101.8. The Negro group as a whole does not average lower in short-term memory than the white normative group (on the basis of DS), in which only 4% have IQ's below 75. DS and IQ were less correlated in the low than in the middle SES groups.

In another study, Jensen (1969) sampled children from grades four through six in an all-Negro school in a low SES neighborhood and from an all-white school in an upper middle class area. Administering the auditory DS and Raven's Colored Progressive Matrices, he found a non-parametric correlation between the two to be .33 for the low SES area (N = 60) and .73 for the upper middle SES group (N = 60). The mean IQ difference between the two schools is two SD's. Comparing the 30 highest scoring children on the DS in a Negro ghetto school (upper 7.9% in DS in grades four through six) with the 30 lowest in the white school (lowest 6.1% in grades four through six). The mean DS scores (percent of the maximum score) was 65.3 for the ghetto school, 38.7 for the white. The corresponding progressive matrices scores were 64.7 and 72.6 respectively.

In a more detailed analysis of auditory digit span and IQ, preschool children were given a series of tests including the auditory digit series of two to nine digits, the Binet and Wechsler DS tests, serial and paired-associate learning of pictures of common objects, the Peabody Picture Vocabulary Test (PPVT). Children were from both a low and a high SES school, the former being predominately Negro, the latter predominately white. The two groups differed 19 points on PPVT, but there was no difference in DS, serial, and PA learning tests. In the high SES group a single factor accounted for most of the variance on all tests. In the low SES group there was a clear separation of intelligence factors from the factor representing DS and learning tests. The low SES and high SES did not differ significantly in means or SD on the Binet or Wechsler DS despite 16 months difference between the mean MA's of the groups. It is concluded that DS has no significant loadings on the intelligence factor in low SES samples and substantial loadings in high SES groups (Jensen, 1969).

Procedure: All of the children in both the experimental and control groups were administered the forward digit span according to the directions given in the WISC manual. Each group (experimental and control) was divided, as before, into younger and older children.

The younger controls achieved a mean digit span of 2.4 and the younger experimentals had a mean digit span of 3.5. The mean digit span for the older controls was 3.4, while that of the older experimentals was 4.7. These results are illustrated in Figure 31. The data were submitted to a 2 x 2 analysis of variance which

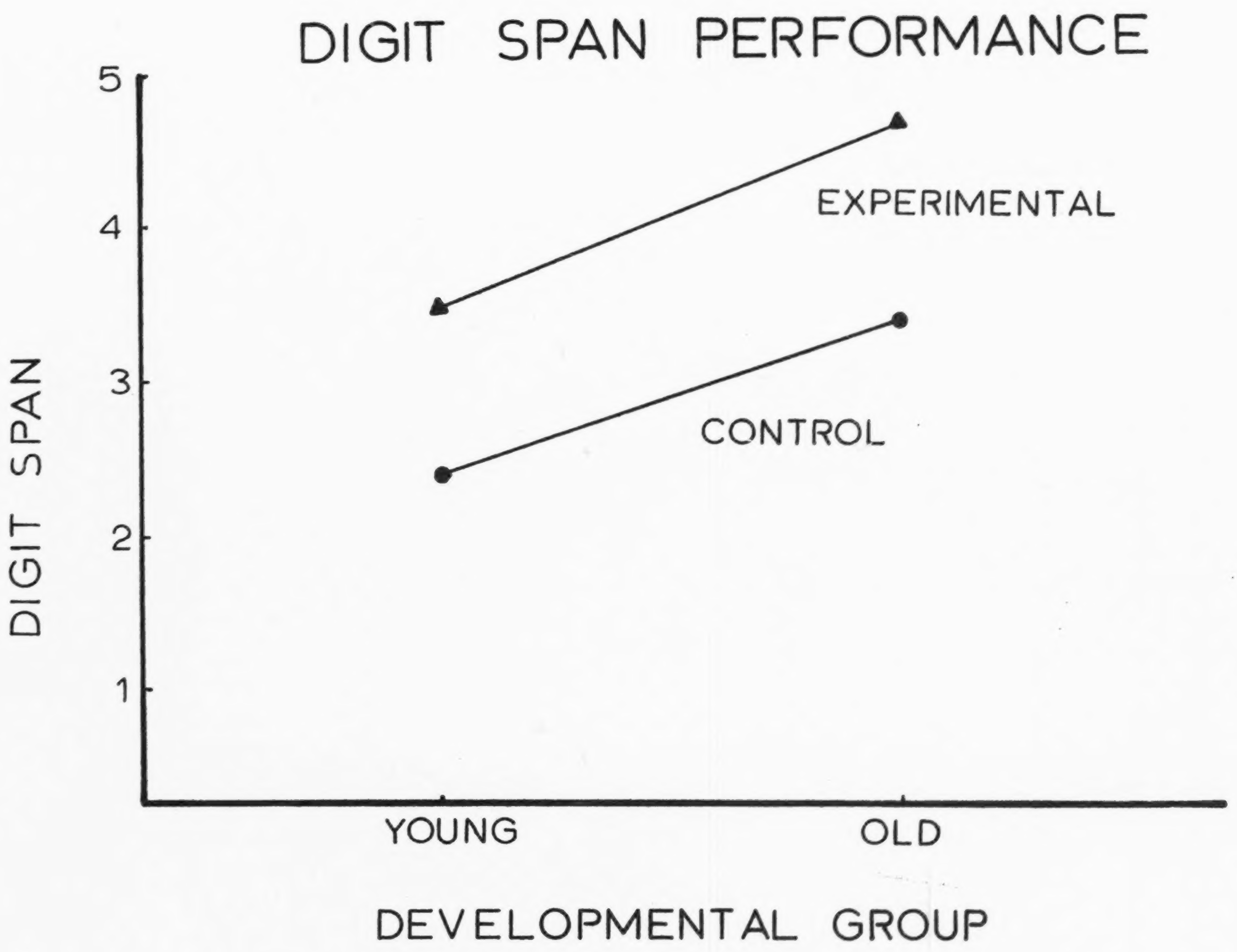

DIGIT SPAN PERFORMANCE
DIGIT SPAN
5
4
3
2
1
EXPERIMENTAL
CONTROL
YOUNG
OLD
DEVELOPMENTAL GROUP

Figure 31

revealed significant main effects of group and age. The older children showed a significantly ($p < .05$) greater digit span. However, this was due mainly to the discrepancy between the older experimental and the younger control groups, since the younger experimental children are comparable to the older controls. The main effect of group is due to the experimental's superior digit span (significant at $p < .025$), including the superior performance of the younger experimentals.

These data stand in contrast to the suggestion by Jensen (1969) that IQ differences do not differentiate digit span differences in low SES children. Indeed, many of the developmental measures used in our program have required a short-term memory facility, and this facility is partly borne out by the differences in performance in this task. Jensen's suggestion that SES alone is a powerful variable sufficient to predict performance on tasks such as this is obviously based on population samples where intellectual performance within a low SES population has not been so discrepant. The digit span task will be readministered at regular intervals.

Ongoing and Planned Learning Tasks

We are continuing with analysis and replication of the preliminary studies. Specifically, replication of the color-form matching task with an additional aspect, measuring appreciation for varied complexity. Further, continued investigation of decision-making by way of probability learning tasks is planned. Varied schedules of reinforcement with varied stimulus configurations are part of the intended updating of the preliminary design investigating this learning phenomenon. The oddity discrimination task has been expanded with more new stimulus material and more categories for responding. In particular, we intend to investigate the role of categorization for young children by the manner in which they can analyze the functional categories of various stimuli. The Ivanov-Smolensky procedure is to be replicated, with particular attention to modification in the procedure, but using the same paradigm. Our work thus far with this technique has shown considerable promise. We shall also implement additional Piagetian tasks. The studies of conservation will be replicated. Digit span will also be replicated.

At this particular time we have just begun to implement our study of the memory process. Retention per se presents somewhat of a logistics problem for our research program in that it could require more than a single session. Furthermore, because of the number tasks we have implemented there has been little extra time available. Now we are approaching an age of verbal fluency and the pre-literate stage so our concerns are focusing more on the memory process and verbal learning ability. Our initial concerns have been with the differential development of the response behavior of the children in the project. As we reported the studies we used, such as color-form matching, sorting, and a probability matching task, are to be repeated again,* but we will introduce this fall of 1971 at least two new tasks as well. These two studies are concerned with perceptual-learning and verbal-learning. Perceptual learning actually is an outgrowth of our earlier interest in differences in stimulus selection (matching and sorting, e.g.) while the verbal learning relates to the oddity-discrimination task. The latter series of studies we feel are related by the nature of our interest in developmental learning ability as basically a developmental attentional process. Indeed our verbal learning study has this same orientation in that our initial study is a paired-associate recognition task in which the subjects are pretrained with labels for the stimulus material. Both studies are presented subsequently with suggestions for the ramification of each.

* (1) the color-form matching (with half the trials) task next spring; (2) the probability task which is now under way; (3) Piagetian paradigms next spring; (4) a modified Ivanov-Smolensky paradigm later this winter; (5) the oddity-discrimination in the summer.

Color-Form Preferences and their Relationship to Visual and Haptic-Tactual, Dispositional, and Incidental Processing of Stimulus Information:

Numerous studies have demonstrated that differential preferences for color and form are influential in concept attainment, discrimination, and reversal learning (see, e.g., Suchman & Trabasso, 1966; Wolff, 1966; Smiley and Weir, 1966). Most of these studies reported in the developmental literature are limited single paradigms. Our research concerns require strategies that will provide not only specific information, but also information on how the learning process operates within a sequence of well-defined tasks.

Color-Form Preferences

A number of studies have investigated the development of color-form preferences in preschool children and adults (see e.g. Brian and Goodenough, 1929; Colby and Robertson, 1942; Huang, 1945; Kagan and Lemkin, 1961; Suchman and Trabasso, 1966; Corah, 1964). Many of these studies have provided evidence for the differential development of preference for color and form as a function of several variables, including I.Q. and CA.

Inasmuch as the developmental continuum of a differential preference for form or color appears to have been identified and established, there are, nevertheless, a number of interesting research questions that have required further corroborations. For example, one question raised by Olmsted and Sigel (1970) was whether or not "color-form preferences were specific to the task or stimuli employed or are they generalized characteristics?" In addition to being a developmental question, the intent of the investigation was to also ascertain information on strategy, methodology, and the kinds of stimuli used. Subsequent data appeared to indicate that color-form preferences were not generalized responses, but rather a function of stimuli and procedures.

There are a number of investigations that have concerned themselves with values inherent in stimuli as contributing factors in determining preferences, and under which of these characteristics children are better able to differentiate. As an example, Huang (1945) has suggested the determinants of preferences to reside in the type and complexities of stimulus material; that children tend to select those stimuli that have the largest number of values (see also Munsinger, Kessen, and Kessen, 1964; Thomas, 1966; Munsinger and Kessen, 1966; Willis and Dornbush, 1968). Piaget and Inhelder (1956) suggested children's preference to be based on asymmetry as opposed to symmetrical form.

Haptic-Tactual to Visual Information Processing

Stevenson and McBee (1958) and Dornbush and Winnick (1966) investigated the ability of children to discriminate among discriminada consisting of stereometric stimulus values and two-dimensional (planometric) projection values. They observed that children responded faster and more accurately on stereometric values than on two-dimensional values. They attributed this difference in performance to levels of information provided by the characteristics of stereometric stimuli (also see Tighe, 1964; Tighe and Tighe, 1966).

Marx (1969) pointed out that inasmuch as intersensory transfer has been definitively demonstrated, little is understood about the precise perceptual processing of this kind of behavior. However, a mediational response(s) has been suggested as a plausible explanation for this level of processing. More recently, Northman and Black (1971) have investigated the developmental ontogeny of visual and haptic-tactual processing.

Mediation

Investigations of the mediation process in young children have attempted to isolate the factors that contribute to the failure of children to successfully mediate stimulus-response paradigms. While many of these investigations have concentrated around the paired-associate paradigm (see review by Reese and Lipsitt, 1970), some studies have dealt with the problem within the optional shift and preference paradigm (see Kendler and Kendler, 1962; Tighe and Tighe, 1970; Trabasso, Stave, & Eichberg, 1969).

A number of hypotheses have been offered to account for the mediational response in the developmental sequence. In summary these hypotheses are:

1. Flavell, et al. (1966) have proposed a production deficiency and mediation deficiency to account for mediation failure. In the former position, there is a failure on the part of the initial stimulus to elicit the mediating response; in the latter position the mediating stimulus fails to evoke the terminal response (see also Corsinsi et al., 1968).
2. Zeiler (1967) has suggested a production error in which an inappropriate stimulus elicits the mediating response.
3. White (1965) has suggested that the mediating response requires a longer

> latency; that in order for mediation to occur the associative response must be inhibited. And, "If the inhibition does not occur, the initial stimulus initiates a covert mediating response and an overt associative response; but the occurrence of the overt associative response terminates the trial." (Reese and Lipsitt p. 259)
>
> 4. Jeffrey (1965) expostulated the notion of "tactical error." The child's strategical planning is impeccable, but the tactics deployed are inadequate.

Stimulus Selection

Macoby (1969) has presented a number of hypotheses on stimulus selection that have direct implications for the proposed study. According to Macoby, a stimulus selection is a function of chronological age and experience.

> Hypothesis II: There is an increase with age in the ability to select a wanted stimulus out of a complex array, even when the selection cannot be accomplished by the differential orientation of the sense organs.
>
> Hypothesis II-A: The increasing ability to select a wanted stimulus is an artifact of the increasing ability to report the wanted stimulus, rather than to perceive it.
>
> Hypothesis II-C: Young children cannot establish a selective set in advance of stimulation, and make use of it to focus attention on certain attributes of a complex stimulus input.
>
> Hypothesis III-A: In divided-attention task, younger children perform less well on the second-reported portion of the stimulus because their memory traces fade faster.
>
> Hypothesis III-C: Young children are not so efficient as older ones in "coding" or "chunking" the material being held in short-term store, and so cannot hold as much.

Incidental Learning

Incidental learning has been identified as a developmental phenomenon. A number of studies have investigated the nature of this phenomenon (see Macoby and Hagen, 1965; and Siegel and Stevenson, 1966). It was found that younger children tended to respond to peripheral incidental stimuli. As the child increases in age and experience, he becomes better able to focus his attention and select relevant-central stimuli from complex stimulus configurations.

These are some of the problems to which the proposed investigation will address itself.

The proposed investigation will concern itself with the differential development of the attentional process and the relationship to response preferences to stimulus values like color form. In other words, there is a hierarchy of attentional responses and response preferences which function in the processing of stimulus information. We will use a succession of four tasks:

Task I: To determine (a) a differential preference for color-form and (b) the hierarchy preference for colors and forms.

Task II: To investigate visual and haptic-tactual perceptual behavior and its relationship to color-form preferences and selection.

Task III: To determine stimulus selection as a function of physical disposition of stimulus under (a) right-left reversal of stimulus; (b) part-whole and missing parts; and (c) orientation of stimulus in space. To also determine whether these behaviors are a function of color-form preference.

Task IV: To determine whether central and incidental information processing are functions of progressive sequences of tasks; and if preference for dimensions is functionally related.

METHODS

Subjects

The subjects will be the children (CA range 2-5 years) from the Experimental Group and the Control Group.

Apparatus

The apparatus to be deployed in the investigation are (1) an automated visual slide projecting instrument on which successive or simultaneous exposures of stimuli and response arrays can be displayed, (see Garber, Heber, and Hagens, 1971) and (2) a haptic-tactual apparatus on which both stereometric and planometric stimuli can be presented successively and/or simultaneously.

Stimuli

The stimuli include three stereometric and planometric forms and colors (triangles, circles, and squares). Only three color hues will be used across all tasks: they are red, green, and yellow. Peripheral-embedded stimuli and missing parts stimuli will be consistent with the general qualitative and quantitative dimensions for the three forms and colors.

Both stereometric and planometric stimuli will be displayed on the automated apparatus to evaluate haptic-tactual to visual information processing. A three dimensional cross along with a two dimensional cross (with and without color) stimuli will be used to demonstrate the procedures and required behavior to each subject for the haptic-tactual task.

Materials

1. Automated Slide Projecting Apparatus (35 mm. slides)
2. Haptic-Tactual Box Apparatus.
3. Slides of stereometric and planometric forms and colors. (triangles, squares, and circles and colors green, red, and yellow).
4. Sears Competition Stop Watch.
5. A white commercial box to cover the haptic-tactual apparatus when not in use.

Procedures

Task I: Color-Form Preference

In the color-form task subjects will be required to select a response from visually displayed stimuli that are simultaneously exposed on the Automated Projection Apparatus (saturated circles, triangles, and squares of three color hues - red, green, yellow - and line drawings of these figures). Standards and models will be balanced for color and form. Two slides will be used to demonstrate and explain how each subject is to respond.

> E: At the top of the screen you can see pictures of objects you may have seen before. At the bottom of the screen are more pictures (pointing to the four color and form stimuli at the botton of the screen). Each one of the pictures at the bottom of the screen has a button below it (pointing to each picture and its corresponding button). Now I want you to look at the pictures at the top of the screen and then select only one picture from the bottom of the screen that you think go with the picture. Use this hand (holding up the subject's right hand and extending the subject's three middle fingers). When you have found the one, press the button under the picture you have selected.

At the end of the demonstration each subject will be run on twenty color-form preference slides. The main task will not start until each subject has fully understood the procedures. A three minute rest period will commence after this task.

Task II: Haptic-Tactual to Visual Processing

After the three minute rest period has terminated, Task II will begin. The box covering the Haptic-Tactual Box will be removed. The purpose and function of the box will be explained to the subjects.

> E: This is a little box that I think you are going to enjoy. The little hole you see (pointing to the hand insert window) is for your left hand (holding up the subject's left hand and subsequently inserting the hand into each window). Now holding the object in your hand but not taking it out of the box, look at the screen to your right (pointing at slide display of a planometric cross, circle, and triangle on the automated apparatus). Do you see a picture on the screen that looks like the object you are feeling in the box? Now press the button under the picture that looks like the object you feel.

The light is subsequently turned off.

> E: When the light is turned off, remove your hand from the box but leave the object in.

This procedure will be done as many times as required until each subject understands how he is required to perform. The control group will receive the same instructions with the exception of visual exposures of the planometric cross.

Task III: Disposition of Stimuli

A. Left-Right Reversal

This task will require subjects to respond to planometric stimuli (color and form) whose positions have been reversed. Two stimuli will be presented simultaneously - one a position relevant standard and the other an opposing irrelevant standard. Reversals of standards and models will be consistent within color, with variations among forms. Twenty variations of reversals will be used.

> E: Now I am going to show you more slides. What I want you to do is find a picture at the top of the screen that goes with a picture at the bottom of the screen. When you have found the picture, press the button below it.

B. Missing Parts

This task will require subjects to select a response that would complete a stimulus standard. Parts of circles, triangles, and squares will be displayed in a response array. A relevant form or color alternative along with an irrelevant cue will make up the possible responses. The question of interest is whether or not the subject selects the appropriate stimuli, the one alternative appropriate cue, or the irrelevant cue. And are the selections consistent with the subject's preferences? This segment will consist of twenty slides.

> E: Now I am going to show you more slides. At the top of the screen you will see a picture you may or may not have seen before. What I want you to do is find a picture at the bottom of the screen that will make this look like a picture you have seen. When you find the picture, press the button under it.

C. Orientation in Space

This task will require subjects to identify and associate a standard of form, color, and form combinations with models in opposing orientations in space.

> E: I am going to show you some pictures that are quite interesting. I want you to find a picture at the bottom of the screen that looks something like the picture at the top of the screen. When you have found the picture, press the button under that picture.

At the conclusion of this sequence subjects will be given a three-minute rest period.

Task IV: Central and Incidental Processing

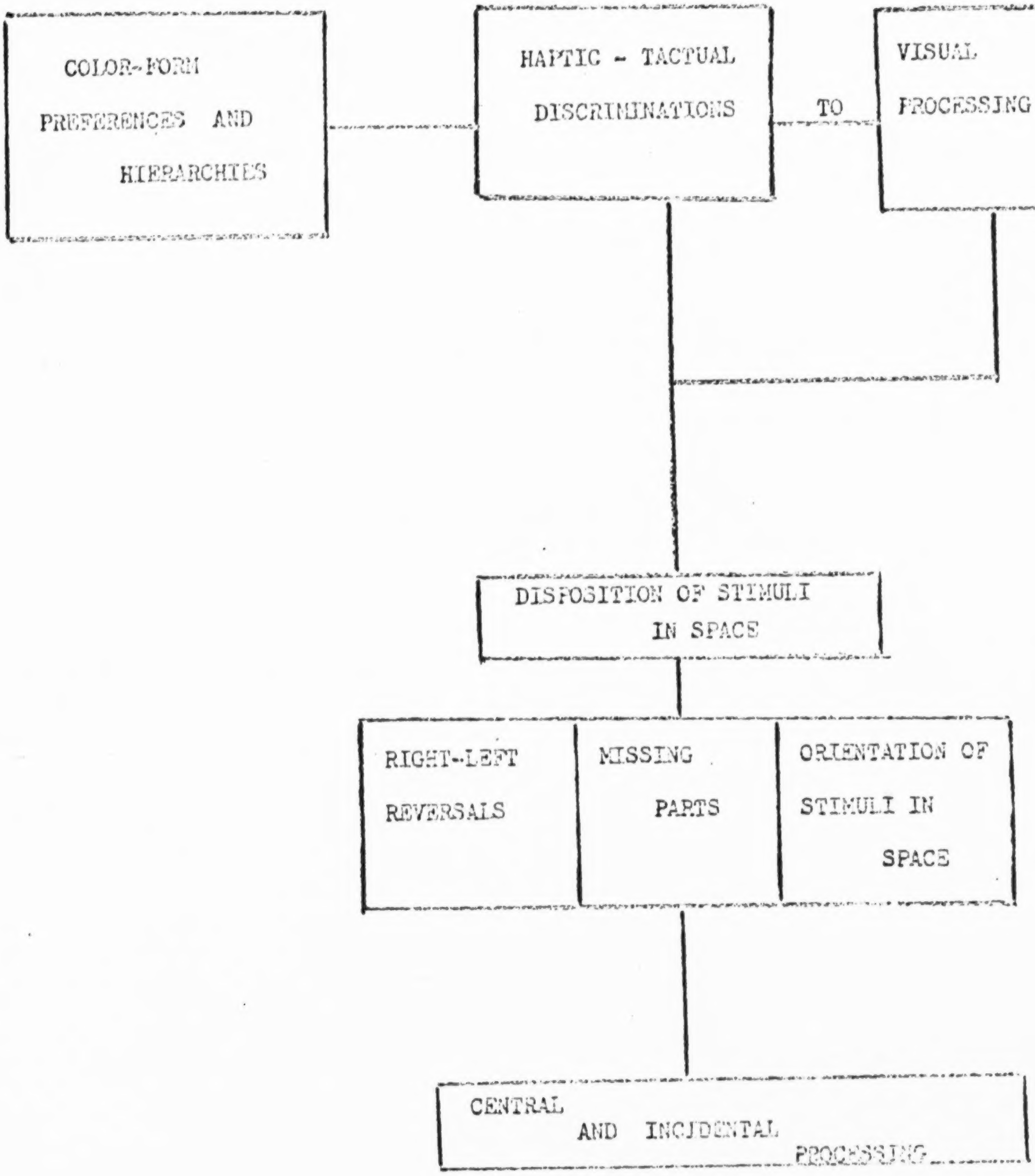
Twenty slides of peripheral-embedded planometric stimuli and their response models will both be presented successively (stimulus exposure followed by its response cues slide). The stimuli will consist of those colors and forms indicated above.

Central processing will be defined as responses to embedded figures while incidental processing being defined as any response to peripheral stimuli of a stimuli configuration. This task is essentially designed to extrapolate and assess information on the subject's ability to attend selectively to specific aspects of a stimulus complex. Task relevant stimuli will be juxtaposed with irrelevant cues in a response array.

> E: Now we are going to play our last game. This game is to see how well you can concentrate on a picture. I am going to show you a picture on the screen for a very short time (about 5 sec. interval) then another slide with three pictures will come up. When those pictures come up, I want you to press the button under the picture you were concentrating on in the first picture you saw.

Four demonstration slides will be used to instruct each subject on how he is required to perform. The control group will not receive instructions on this segment.

DESIGN SCHEMA


COLOR-FORM PREFERENCES AND HIERARCHIES
HAPTIC - TACTUAL DISCRIMINATIONS
TO
VISUAL PROCESSING
DISPOSITION OF STIMULI IN SPACE
RIGHT-LEFT REVERSALS
MISSING PARTS
ORIENTATION OF STIMULI IN SPACE
CENTRAL AND INCIDENTAL PROCESSING

Differential Development of Verbal Learning Abilities:

Various techniques, e.g. free word association, paired associate and close learning tasks, have been employed to study extralinguistic behavior and the verbal abilities characteristic of different age groups as well as different IQ levels and ethnic socioeconomic classes. Extralinguistic behaviors include memory processes and conceptual properties which dominate words or word pair associations. Included in this list are environmental experiences of the individual which have considerable effect on his performance in a learning task.

Various methods of presentation and different numbers and types of pairs can be used to trace and facilitate the development of thought processes which result in proficient learning. Researchers have manipulated the paired associate task in order to modify learning deficits exhibited by low IQ children compared with MA matched normal children. Where retention and discrimination deficits have been found in retarded subjects, modifications in the presentation of the paired associate task have been successful in "equating" the performance of retardates and MA matched normals by using such techniques as: (1) overlearning or longer exposure times for items (Prehm and Stinnet, 1970; Goyen and Lyle, 1971); (2) individual training, reinforcements and incentives (Bricker and Bricker, 1970); (3) meaningful material; (4) relevant pretraining, learning-to-learn (Goulet, 1968; Kellas and Butterfield, 1970; Bricker and Bricker, 1970; Cantor, 1965); (5) high free associative strength (Gallagher and Reid, 1970); (6) provision of verbal or visual mediators (Jensen, Rohwer et al., 1969); (7) asking for recognition vs. production of the response items (Borkowski and Johnson, 1968). Any of these above mentioned techniques for facilitating behavior acts differentially as a function of the developmental level. How these factors might facilitate the learning of behaviors in a PAL task in very young children of different developmental levels is not clear since so few studies have focused on verbal learning in children under seven (Gallagher and Reid, 1970; Gallagher, 1969). Research in this area would particularly contribute to developmental theory, as success in learning a paired associate task depends on discrimination and memory processes. Development of these processes are particularly important for the developing reading skills. Studies by McCullers (1965) and Otto (1961) have shown that paired associate learning is positively correlated with scores on tests of IQ and reading skills. An important part of this learning process involves selectively attending to the relevant stimuli cues and labeling them for storage.

Our interest is how verbal abilities act to influence learning in memory tasks. Labelling is but one performance characteristic, usually covert, that is employed by individuals to code and store information. However, the nature and the facility with which information is labelled is critical for retrieval. In other words, labelling (identifying or coding) information for storage can either facilitate or interfere with retrieval. This concern is the focus of this investigation.

This study was designed to examine whether the facilitation provided by pretraining with verbal labels in a classificatory task acts differentially as a function of the level of cognitive development. This question is related to the Hawkins-Spiker experiments which examined some of the conditions which influence kindergarteners' choice of stimulus cue to be used in a learning task. They concluded that supplying verbal labels for multidimensional stimuli is one of the conditions which can facilitate performance of young children.

Using both younger and older preliterate children, the present experiment predicts the differential facilitation of learning in a paired associate task effected by "verbal label" pretraining as a function of developmental level. In other words, the differential effects of verbal labeling will increase with age and IQ.

METHOD:

Ss: The subjects for the study are participating in our infant stimulation project in Milwaukee. The subjects are divided into experimental and control subgroups.

Apparatus: The apparatus used for the tasks is the Wisconsin Learning Research machine (described elsewhere: Garber, Heber, and Hagens, 1971).

Task: Three paired associate tasks will be administered to each of the four subgroups. For each task each stimulus will be presented with the four response items, and the subject will choose the correct response.

I. For the first task, stimulus items will consist of pictures of four colored shapes (circle, square, triangle, cross). Each form will be paired with a black and white picture of a concrete object (kite, clock, dog, cup). Each of the stimulus forms will be presented in four different colors.

II. For the second task, stimulus-response items will consist of four picture pairs of objects which have a meaningful relationship. There is a functional relationship between the items of each pair. The stimulus item will be labeled in pretraining.

III. For the third task, stimulus-response items will consist of four picture pairs of objects which have a meaningful relationship. As in the second task, stimulus items will be functionally related to the response items. The function of the stimulus will be described in pretraining.

(Intralist similarity of stimulus and response items is minimized.)

A 2 X 2 X 3 factorial design will be employed. The independent variables will be group, age, and tasks.

Instructions and Procedure:

In the first task, all four groups are pretrained with verbal labels for each stimulus. Subjects are instructed to respond to each form-color stimulus with the name of the form. During the actual task, the stimulus item is presented on the top half of the screen with the four response items presented on the bottom half. Subject is instructed to push the button under the response he thinks the stimulus is paired with. The correct response is coded by means of holes punched in the cardboard slide, and automatically recorded by means of a photocel sensing device. When a correct response is made, machine advances to the next slide. When an incorrect response is made, the response button remains lit and the screen darkens, and then the stimulus item is redisplayed. This is repeated until the correct response is made. Positions of response items are balanced on presentations.

Scoring will consist of the number of correct responses made per trial after the first trial and the number of trials needed to make a criterion of three consecutively correct responses to a stimulus item or a criterion of three correct trials.

The first of the three tasks is a modification of the Hawkins-Spiker (1966) minimum pretraining experiment. They found that in a PAL task, even minimum relevant pretraining facilitated learning (rapid learning, number of correct responses, and even minimal irrelevant pretraining interfered with performance. The control group improved steadily with trials but not to the degree of the relevant group. Scoring consisted of the mean correct anticipations per trial. They also concluded that the dimension used in pretraining had a strong influence on the S even when other dimensions of stimulus items are in the child's repertoire.

Our next two tasks are composed of functionally related item pairs. These should be significantly easier than the first task for a subject who uses mediators to relate the two items--i.e., selectively attended to the stimulus dimension or cue (function of stimulus item in above examples) which is related to the response item.

Studies employing the anticipation method have shown that overt mediation of S-R items by the examiner in pretraining can facilitate learning of a PAL task (MacMillan, 1970; Rohwer, 1969; Milgram, 1968; Reese, 1965). The stimulus response items used in the above studies were not highly related, however, so that if there was not an overt elaboration, the subjects would have had to mediate the items in some idiosyncratic way to facilitate retrieval of the pairs. MacMillan used mediating statements for the stimulus response items in studying children in intermidiate elementary classes for retardates. He found that the greatest number of errors for experimental subjects were those items mediated in a less meaningful sentence (e.g., The cup wore glasses.). Verbal mediators were also used by Rohwer and Ammon (1969) and by Milgram in his study of normal children (MA range 3.9 - 5.9) and retarded (MA range 2.11 - 5.7). Results of studies done by Reese (1965) and Rohwer and Ammon (1969) showed that visual mediators also facilitated the learning of a PA list for young children. The facilitating effect of overt mediators, however, depends upon the free associative strength value of items and/or developmental level of the individual. Gallagher and Reid (1970) studied the effect of five different FAS values of paired associate items on the performance of institutionalized (third grade level), MA matched normals, and first grade normals. Results showed that the retardates and MA matched normals did better on FAS high materials than lower MA normals did, although all groups did significantly better on high associated pairs than on weak or non-associated pairs. As FAS values decreased, however, performance of retarded subjects became similar to that of lower MA normal group.

In studying the developmental progression of bases of organizing free recall words, Rossi and Witrock (1969) found that clustering of conceptually related items showed positive linear trend with intelligence. Clustering responses peaked at MA 4, rhyming at MA 2, syntactic at MA 3, and serial (memorizing by means of rehearsal strategies rather than other bases for grouping) at MA 5. Results are consistent with Piaget's theory of development from concrete to abstract thought processes. Results of Laurence's study (1967) of preschool and kindergarten children showed that subjects recalled greater number of words from a list of conceptually related pictures than from a list of conceptually unrelated items.

Thus our tasks are designed to study such cognitive processes as are operative in preschool and kindergarten subjects--i.e. specifically, whether designating the existence of functional relationships can serve as a mediating cue for facilitating selection of paired-associate items.

For the second task, all four groups are pretrained with verbal labels for the stimulus items. Each stimulus item will then appear on the top half of the screen while the four response items will appear on the botton half. The procedure is the same as that involved in the first task.

The third PA list will also consist of functionally related pairs. However, the groups will be pretrained with the functional description of the stimulus item (e.g., "You chop with this," for the stimulus picture of a hatchet). The presentation of stimulus response items and procedure will be the same as that of the first two tasks. Again it is hypothesized that the facilitating effects of verbal labeling or verbal description of the stimulus items depends on the developmental level of the subject.

ADDITIONAL STUDIES IN VERBAL LEARNING USING THE PAIRED ASSOCIATE TASK

1) Interpolated delay activity.
    - A. A-B, A-C, A-B paradigms
        - a) where B and C are not related
        - b) where B and C are related
    - B. task other than PA task
2) Increased number of stimuli and/or responses.
3) Increased intralist similarity of response items.
    - A. swing, cup, tent
    - B. bird, dog, fish
    - C. truck car, bicycle
    - D. football, baseball, basketball

The first task would be designed to study the effects of external interference and transfer processes on performance.

The second task would be designed to study the effects of interference on retention due to increased number of items.

The third task would be designed to study the effects of interference due to higher discriminability items and categorization processes involved.

BIBLIOGRAPHY

Achenbach, T. M. "Conservation" below age three: fact or artifact? Proceedings of the 77th Annual Convention of the American Psychological Association, 1969, 4, 275-276.

Bayley, N. Comparisons of mental and motor test scores for ages 1-15 months by sex, birth order, race, geographical location, and education of parents. Child Development, 1965, 36, 379-411.

Birch, D. Verbal control of nonverbal behavior. Journal of Experimental Child Psychology, 1966, 4, 266-275.

Bruner, J., Olver, R. R. and Greenfield, P. M. Studies in Cognitive Growth. New York: Wiley, 1966.

Ellis, N. R. The stimulus trace and behavioral inadequacy. In N. R. Ellis (Ed.), Handbook of Mental Deficiency. New York: McGraw-Hill, 1963, 134-158.

Flavell, J. The Developmental Psychology of Jean Piaget. Princeton, N. J.: Van Nostrand, 1963.

Fowler, W. Cognitive learning in infancy and early childhood. Psychological Bulletin, 1962, 59, 116-152.

Goldschmid, M. L. Different types of conservation and nonconservation and their relation to age, sex, MA, and vocabulary. Child Development, 1967, 38, 1229-1246.

Gollin, E. S., Saravo, A. and Salten, C. Perceptual distinctiveness and oddity-problem solving in children. Journal of Experimental Child Psychology, 1967, 5, 586-596.

Goodnow, J. J. and Bethon, G. Piaget's tasks: the effects of schooling and intelligence. Child Development, 1966, 37, 573-581.

Griffiths, J. A., Shantz, C. A. and Sigel, I. E. A methodological problem in conservation studies: the use of relational terms. Child Development, 1967, 38, 841-848.

Gruen, G. E. Experience affecting the development of number conservation in children. Child Development, 1965, 36, 963-979.

Gruen, G. E. Note on conservation: methodological and definitional considerations. Child Development, 1966, 37, 977-983.

Harlow, H. The evolution of learning. In A. Roe and G. G. Simpson (Eds.), Behavior and Evolution. New Haven, Conn.: Yale University Press, 1958.

Heber, R., Dever, R. and Conry, J. The influence of environmental and genetic variables on intellectual development. In H. Prehm, L. Hammerlynck and J. Crosson (Eds.), Behavioral Research in Mental Retardation. Eugene, Ore.: University of Oregon Research and Training Center Monograph No. 1, 1968.

House, B. J. Oddity performance in retardates: I. acquisition and transfer. Child Development, 1964, 35, 635-644.

Huang, I. Abstraction of form and color in children as a function of the stimulus objects. Journal of Genetic Psychology, 1945, 66, 59-62.

Inhelder, B. and Piaget J. The Early Growth of Logic in the Child. New York: Harper and Row, 1964.

Jarvis, P. W. Verbal control of sensory-motor performance: a test of Luria's hypothesis. Human Development, 1968, 11, 172-183.

Jensen, A. R. How much can we boost IQ and scholastic achievement? Harvard Educational Review, 1969, 39, 1-123.

Kennedy, W. A., Van de Riet, V. and White, J. C., Jr. A normative sample of intelligence and achievement of Negro elementary school children in the southeastern United States. Monographs of the Society for Research in Child Development, 1963, 28(6).

Kingsley, R. C. and Hall, V. C. Training conservation through the use of learning sets. Child Development, 1967, 38, 1111-1126.

Lipsitt, L. P. and Serunian, S. A. Oddity-problem learning in young children. Child Development, 1963, 34, 201-206.

Luria, A. R. The mentally retarded child. Essays Based on a Study of the Peculiarities of the Higher Nervous Functions. New York: Macmillan, 1963.

Mehler, J. and Bever, T. G. Cognitive capacity of very young children. Science, 1967, 153. 141-142.

Mermelstein, E. and Meyer, E. Conservation training techniques and their effects on different populations. Child Development, 1969, 40, 471-490.

Mermelstein, E. and Shulman, L. Lack of forman schooling and acquisition of conservation. Child Development, 1967, 38, 39-52.

Piaget, J. The Child's Conception of Number. New York: Humanities, 1952.

Rothenberg, B. and Courtney, R. Conservation of number in very young children: a replication of and a comparison with Mehler and Bever's study. Journal of Psychology, 1968, 70, 205-212.

Rothenberg, B. and Orost, J. The training of conservation of number in young children. Child Development, 1969, 40, 707-726.

Siegel, I. E. and Hooper, F. H. Logical Thinking in Children: Research Based on Piaget's Theory. New York: Holt, Rinehart and Winston, 1968.

Siegel, L. S. and Goldstein, A. G. Conservation of number in young children: recency versus relational response strategies. Developmental Psychology, 1969, 1, 128-130.

Shantz, C. U. and Smock, C. D. Development of distance conservation and the spatial coordinate system. Child Development, 1966, 37, 943-948.

Smedslund, J. The acquisition of conservation of substance and weight in children, III: extension of conservation of weight acquired "normally" and by means of empirical contrast on a balance scale. Scandinavian Journal of Psychology, 1961, 2, 85-87.

Smith, I. The effects of training procedures upon the acquisition of conservation of weight. Child Development, 1968, 39, 515-526.

Suchman, R. G. and Trabasso, T. Stimulus preference and cue function in young children's concept attainment. Journal of Experimental Child Psychology, 1966, 3, 188-198.

Wohlwill, J. F. and Lowe, R. C. Experimental analysis of the development of the conservation of number. Child Development, 1962, 33, 153-167.

SOCIAL-PERSONALITY DEVELOPMENT

The next major area of assessment concerns aspects of personality development. In addition to the kind of experimental measures of infant learning and performance previously described, a number of techniques have been devised to assess differences in parent-child interaction between the Experimental and Control group mothers with their children. In our general conceptualization (See Figure 32), the child is the center of an input-feedback system which involves both the parent and extra-familial stimulation.

To date we have completed a preliminary observation and analysis of a structured parent-child situation. The entire session is videotaped and recorded and provides the data for not only the problem-solving performance of mother and child, the relationship of the mother and child, but also the nature of the language used by the mother in communication with the child. There are several studies subsequently planned for this winter and spring including a replication of the unstructured play situation for observing aggression.

We are also attempting at this time to assess the quality and nature of the home environment by using an interview questionaire (modified from Caldwell, 1968) which is administered in the home. The questions deal with specific expectations of behavior from the child, in day-to-day living, and the amount of freedom, attention and stimulation he is given in his home environment.

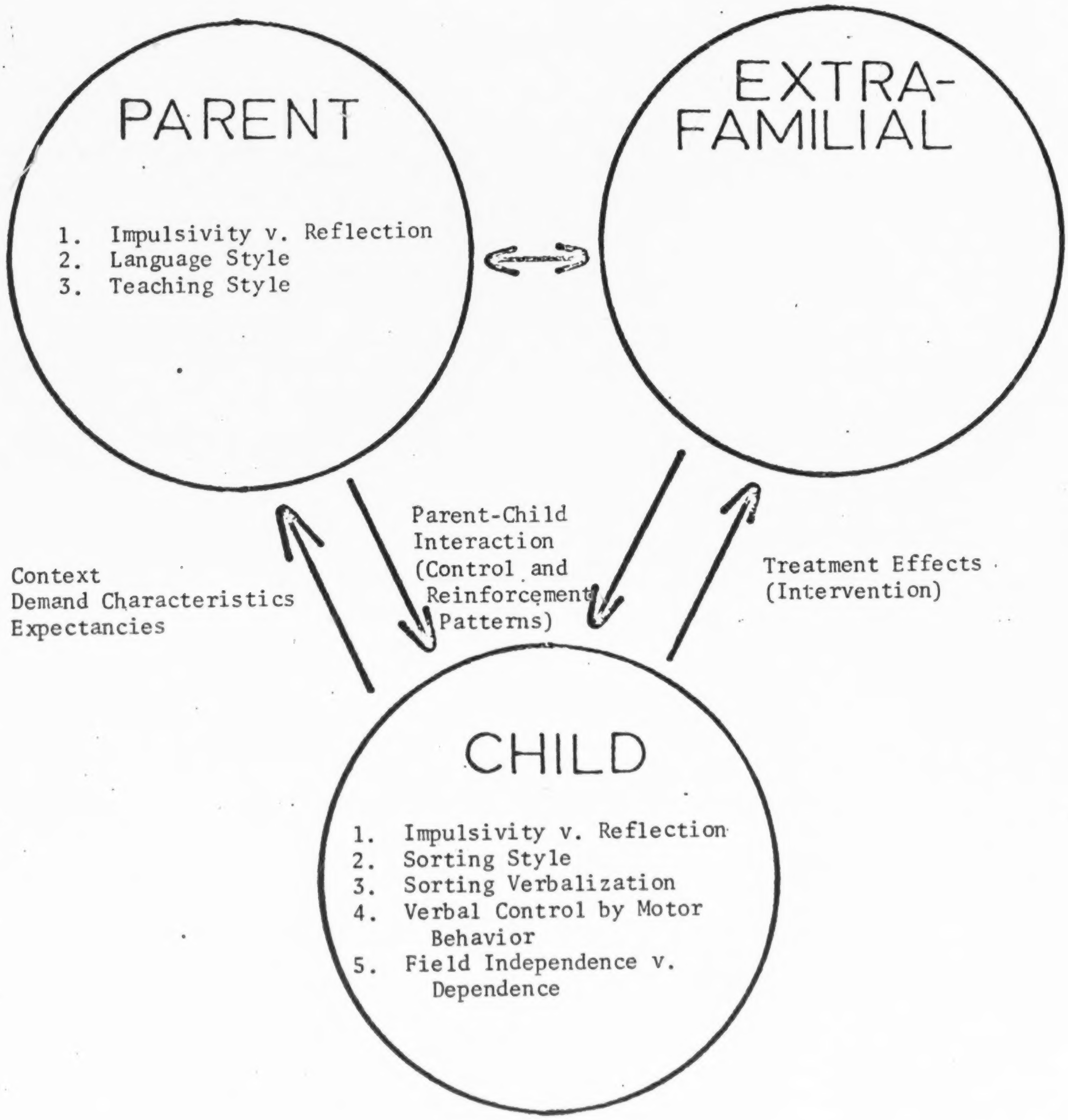

PARENT
1. Impulsivity v. Reflection
2. Language Style
3. Teaching Style
EXTRA-FAMILIAL
Context
Demand Characteristics
Expectancies
Parent-Child
Interaction
(Control and
Reinforcement
Patterns)
Treatment Effects
(Intervention)
CHILD
1. Impulsivity v. Reflection
2. Sorting Style
3. Sorting Verbalization
4. Verbal Control by Motor Behavior
5. Field Independence v. Dependence

Figure 32

Sources of Stimulation and Measures of Cognitive Development:
The Conceptualization of the Components
of the Mother-Child Interaction

Form of Aggression in Young Children

A previous research effort observed the children at play in a playground setting so that we might evaluate the nature of their interaction with peers--particularly the manner in which they express aggression. A review would be helpful here of our previous report, particularly since the data has been further analyzed and is formally reported in a paper in the Appendices of these reports.

The relationship of socioeconomic status to aggression is not clear. Whereas Davis and Havighurst (1946) report that middle class parents place their children under a stricter regimen with more frustration than did the lower class parents, who were more permissive of aggression, Sears, Maccoby and Levin (1957) found lower class Bostonians to be more restrictive and punitive than the middle class. Bronfenbrenner (1958) accounts for such disparate findings by questioning not only the validity of the basic interview method typically used in these studies, but also the lack of knowledge of the role of such variables as ethnicity, religion, urban versus suburban residence, and strength of mobility strivings.

Observation of aggressive behavior within a structured school setting supports the relationship of SES and the expression of aggression. Muste and Sharpe (1947) found aggressions were almost twice as frequent in a college nursery school class than in an industrial day care center similarly rated. Body (1955) qualified SES differences in observed aggressive behavior by finding that a university nursery school group gave a greater number of aggressive verbal responses and were generally more active than tuition-free day care children, who were more physically aggressive. In addition, Appel (1942) reported that while high SES nursery schools had more "cross-purpose" conflicts (behavior resulting in conflict over ways of using toys or equipment, or methods of pursuing imaginative play), the low SES school children were most frequently aggressive in their desire for possession of articles.

The form of aggressive behavior is developmentally related to age of the child involved. Appel (1942) found aggression to be predominantly physical in two-year-olds, with more verbal aggression in the four-year-old group. Walters, Pearce and Dahms (1957) reported that four- and five-year-olds tend to express aggression verbally, not physically. Generally, then, aggression tends to change qualitatively with age from two to five from predominantly physical to predominantly verbal.

Consistent findings have been reported relating sex to aggression. Muste and Sharpe (1947) found that aggressions between children of the same sex are prevalent over aggressions between opposite sexes; however, both boys and girls were most aggressive when paired with other boys. These data were derived from children in structured play as contrasted with children in a free play situation, where children choose their own partners. Several other studies (e.g., Body, 1955; and Walters, Pearce, and Dahms, 1957) have similarly reported boys exhibit a greater number of aggressive behaviors than girls in a play setting.

A major problem that remains is the development of an instrument which can be used to evaluate children's aggressive behavior. Central to this problem is the difficulty in determining the categories of aggression; how to relate the behavior to its object and to the situation; and the specification of the appropriate independent and dependent variables involved. Thus, it would seem valuable to direct some efforts toward developing such an instrument which could be used to evaluate aggressive behaviors by a variety of children in a variety of settings.

The purpose of this study was to develop such an instrument and to measure its effectiveness with our two groups of very young children. Based on previous research, the experimental group was expected to be more aggressive than the control group, and the frequency of aggressive behaviors was expected to be greater for both groups during a mixed play (Experimental and Control) condition than during an intact play condition. But, it was also expected that the quality of the Experimental group's aggression would be different. In other words, it was expected that the Experimental group would enact a greater number of verbally aggressive behaviors than the Controls, and that girls would be less aggressive than boys, with the boys enacting a greater amount of physical aggression.

Method

The basic design of the experiment was a two (Experimental versus Control) by two (intact versus mixed) factorial design. The Experimental group of children were participating in a daily preschool program. The Control group of children were a comparable group of children to the Experimental group, but did not participate in the daily program. Under the intact condition, each group was observed independently, while under the mixed condition, the groups were observed playing together.

Subjects

Subjects were 18 black children between the ages of 18 months and three years. Nine were the oldest children participating in the preschool education program, begun when they were six months old. The other nine were from the Control group. The mean age of the Experimentals was 32 months and that of the Controls, 29 months. The Controls were originally matched to the Experimental group on the basis of CA and level of maternal intellectual functioning and were not participating in the stimulation program. All subjects were from a low SES area in Milwaukee. There were five males and four females in each group.

Instrument

The instrument used was a rating scale with six categories of verbal and six of physical aggression. It was adapted from a scale used by Walters, Pearce and Dahms (1957). The scale divides aggressive behavior into two general categories: verbal aggressive behaviors and physical aggressive behaviors. There are six categories of verbal aggression: 1) cross-purposes -- argues over the use of equipment, or over the method of pursuing imaginative play; 2) claims possession -- verbally demands something another child is using (e.g., "give me that"); 3) refuses to obey verbal instructions -- verbally discounts an instruction (e.g., "I won't do that"); 4) shifts the blame or tattles (e.g., "Jimmy hit Mary"); 5) threatens or verbally blocks activities of others (e.g., "I'll hit you if you come any closer," or "you can't use the sand"); and 6) mocks, calls names, insults, indicates dislike verbally. The six categories of physical aggression are: 1) threatens -- waves hands or legs as if to hit or kick; 2) pursues -- runs after another as if to attack him; 3) snatches or damages the property of others -- knocks over blocks, grabs a toy someone else was playing with; 4) hits, strikes, kicks -- uses hand or leg to attack; 5) blocks play of others -- physically blocks another child's entrance into a section of the room or yard; and 6) pulls, pushes, holds -- uses whole body to knock over, to move another child or object.

Procedure

A week before the actual observations were made, all the raters practiced synchronized time-sequenced recording to establish inter-rater reliability with the rating scale. Nursery school children were observed and rated for two-minute intervals in a pre-arranged order so that all raters were rating the same child at the same time. Any between-rater discrepancies were discussed. This continued until all the raters were consistently reliable.

There were two conditions: intact and mixed. Under the intact condition, each group was observed separately. In the mixed condition, the groups were combined for observation. Ratings for the intact condition were made in an outdoor playground which contained a sandbox, jungle gym, slide, and two swings. Ratings for the mixed or combined condition were made indoors, in the preschool gymnasium. In the gymnasium were two miniature slides, three tricycles, one ball, one doll carriage, and one horse on wheels. On the first morning the children from the Experimental group were taken by station wagon from the preschool center to the playground for the 45-minute session, and then returned to their classrooms. The next morning the Control children were picked up at their houses, one by one, and taken to the same playground. Immediately following this session, the Controls were taken from the outdoor yard to the preschool gym and the Experimentals were brought in from an adjoining room. After 45 minutes in the mixed condition, the Controls were returned to their homes and the Experimentals to their classrooms.

In addition to the five raters present, there was a playground supervisor who was equally familiar to the Experimental and the Control groups. The raters and the supervisor were all female students.

Design

Day I: Experimental group 45-minute play period
(Experimental Intact Condition)

Day II: Control group 45-minute play period
(Control Intact Condition)

Day III: Experimental and Control group combined for 45-minute play period (Experimental Mixed Condition and Control Mixed Condition)

Results

During the study, the five raters made two-minute overlapping time-sequence ratings of each child for each group in each condition. An evaluation of the ratings showed an inter-rater reliability of .73.

An analysis of variance performed on the data revealed that the group main effect was significant at $p<.10$ ($F_{1,16} = 3.93$). The Experimental group had a larger number of aggressive behaviors than the Control group. Further, under the mixed condition there was a significantly greater number of aggressive behaviors than under the intact condition ($F_{1,16} = 11.22$; $p<.005$). Also, the analysis revealed a significant interaction ($F_{1,16} = 3.14$; $p<.10$) indicating that the Experimental and the Control groups had an increasingly different amount of aggression in the mixed condition over the intact.

Since the analysis of variance revealed a significant interaction, Dunnet's test was applied to the group means involved. The t-test revealed significant differences in the Experimental intact versus the Experimental mixed ($t = 3.6$; $p<.01$); between the Experimental intact versus the Control intact ($t = 2.31$; $p<.05$); and between the Experimental mixed versus the Control mixed ($t = 4.82$; $p<.002$). There was no significant difference between the Control intact group versus the Control mixed group. The Experimental mixed enacted more aggressive acts than any other group condition.

The data were then analyzed separately for the three phases of the experiment to examine differences in aggressive behaviors as a function of the various categories of aggression, the sex of the aggressor, and the object of aggression. Upon analyzing frequency of aggressive behaviors as a function of these categories, it was found that the Experimentals in the intact group condition enacted 65% of their total aggression physically, as compared to 100% for the Control intact group condition. A t-test of the group means indicated significantly ($t = 10.0$; $p<.001$) more verbal aggression was enacted in the Experimental intact group condition than in the similar Control group condition.

For the Experimental children, nearly half of the verbal aggression enacted was categorized as cross-purpose (i.e., argument over specific or imaginary use of equipment). There was essentially no verbal aggression for the Control group in the intact condition. For the mixed condition the raters specified that the verbal aggression recorded was not comprehensible: it consisted of yelling and screaming. In contrast, verbal aggression by the Experimentals in the mixed condition was primarily manipulative (verbal blocking, threats, claiming possession and cross-purposes accounting for 85% of all Experimental intact and mixed condition verbal aggression).

Upon analyzing the aggressive behavior by sex of the aggressor, it was found that males performed 85% of the physical aggression enacted within the Experimental intact group and 91% of the verbal aggression by that group. Males performed 50% of the physical aggression in the Control intact condition; there was no verbal aggression. In the mixed condition, 84% of the Experimentals physical aggression and 70% of their verbal aggression was by males. In the Control mixed condition, 47% of the physical aggression and 100% of the verbal aggression was by males. Thus, aggressive acts were more often physical than verbal, and more often enacted by males than females.

Discussion

In general, results support the two main assumptions of the study. First, that the Experimental group would be more aggressive than the Controls in all conditions; and secondly, that more aggressive behaviors would be enacted in the mixed-group condition than in the intact-group condition. Moreover, although both groups increased in the number of aggressive behaviors enacted between the intact-group condition and the mixed-group condition, the Experimental group increased significantly more than the Controls. The amount of this aggression exhibited by the Experimentals was significantly more than either group in either condition. Furthermore, the greater usage of manipulative verbal aggressive behaviors (cross-purpose, claiming possession, verbal blocking) by the Experimental group is usually a reflection of the qualitative developmental shift from physical to verbal aggression associated with older or higher SES children. In contrast, the Control group exhibited no manipulative aggression, only attention evoking noise. Such between-group (Experimental versus Control) differences can be attributed to a differential treatment effect; i.e., the Experimentals' participation in the infant stimulation program, in contrast to the Controls who did not participate. The differences in the frequency of aggressive behaviors between the two group conditions (intact versus mixed), on the other hand, could be attributed to the disinhibitory effects discussed by social learning theory. Based on this theory, the aggressive children would serve as models for observing children to imitate.

Differences in the frequency and quality of aggressive behaviors between the Experimental group and the Control may be attributed to the treatment effects, i.e., the Experimentals' participation in the preschool program, which was not participated in by the Controls. During the course of the early education program, an emphasis was placed upon verbal and expressive behavior, with acting out as a means of expression. Through class interaction with a teacher, the children were urged to initiate their own expressive speech and to function creatively in problem-solving situations. In contrast, the environment of low SES homes in which the Controls spent much of their time has been described as lacking in consistent, articulate content, with a high noise level but little direct feedback in parent-child interaction. One theory (Hess and Shipman, 1968) is that interactions are based upon control by imperatives. The parent in these low SES homes does not reason with the child, but uses commands to regulate the child's behavior.

Based upon these considerations, the differences observed in the frequency of aggressive behaviors of the two groups can be attributed to the differences in their environment over the previous past two years of their lives.

The Experimental group has had exposure to the two or more years of the preschool program where verbal expressive behaviors are emphasized. It seems that the emphasis on verbal behavior in such stimulation programs counteracts developmental deficiencies and results in levels of behavior comparable to higher SES and older children. In addition, the results provide evidence for variation in aggressive behavior in group situations and changes in such behavior developmentally. Although it is not possible to evaluate the instrument apart from the results obtained, its ability to measure differences in behavior between the two groups indicated the usefulness of such an instrument in evaluating aggressive behavior.

Assessment of Mother-Child Interaction and the Development of Cognitive Style

Investigations of the role of early environment upon cognitive development of the child has two approaches: 1) retrospective investigations, which attempt to relate the status variables of SES and race to intellectual performance; and 2) observational investigations, which quantify process variables, such as interpersonal communication within the home, and relate them to intellectual performance. Eventually the process variables are reported as styles of responding.

Researchers using the retrospective approach have found that learning and achievement vary as a function of SES. For example, Milner (1951) divided first graders into a high and a low group on the basis of reading and language test scores. She found that social class was also a concomitantly distinguishing factor between the two groups; in fact there was only one low SES child among the high scorers and only one middle SES child among the low scorers. Mimbauer and Miller (1970) compared the performance of middle and low SES preschoolers on a series of learning tasks. The middle class group performed significantly above the low SES group on all tasks. In addition, there was a mean IQ difference between the groups of nearly 30 points in favor of the middle SES children.

Although such studies evidence the existence of differences between SES groups, they have provided little information about the nature of these differences. The Milner (1951) study, however, included children's responses to questions about the home environment and maternal interview. This data revealed the "high" test group exhibited significantly more responseswhich expressed appreciation of the time the mother spent in such activities as taking the children places and reading to them. Also, these children possessed at least several storybooks, which the parents spent time reading to them. The relationship that Milner reveals between home variables and achievement points to the importance of process variables in intellectual development. Dave (1963) reported a correlation of .80 for six home environment variables and 4th graders' total scores on an achievement battery. These process characteristics were summarized in six variables of the home environment relevant to educational achievement: 1) Achievement pressure; 2) language models in the home; 3) academic guidance provided in the home; 4) stimulation provided in the home to explore various aspects of the larger environment; 5) intellectual interests and activity in the home; 6) work habits emphasized in the home. Dave's correlation of .80 stands in sharp contrast to much lower correlations (less than .50) obtained for the relationship of SES and school achievement, education of the parents, and father's occupational status. This data suggests that what the parents do in the home, rather than the family characteristics, is most important.

More detailed investigations have been implemented in order to understand the nature of the mother-child interaction and how this process influences the child. There seems, in addition to the general differences in the pattern of mother-child interaction, that there are patterns peculiar to SES levels. Bernstein (1960), Hess and Shipman (1965), and Kagan (1965) have produced particularly important research in this regard.

Bernstein (1960) distinguished between a restrictive and an elaborative speech pattern: the former referring to imperative speech, which orders without explanation of rationale; the latter to speech which describes causal and contextual relationships. These speech patterns were found by Hess and Shipman (1965) to be used in the interaction of a mother and child by the mother to exert regulatory control of the child's behavior. In turn, the type of control can be sub-divided into two categories: 1) imperative-normative and 2) cognitive-rational. Hess and Shipman (1968) found that whereas middle class mothers essentially used the cognitive-rational control style in teaching their children, lower class mothers used imperatives. The use of imperative controls to regulate behavior is correlated with lower maternal intelligence. In addition it is related to the use of relational grouping strategies in which one stimulus obtains its meaning from its relation with other stimuli, e.g. doctor:nurse. The use of relational groupings suggests relatively low attention to external stimulus details, subjectivity, and a categorical style of thinking. Hess and Shipman have concluded that information in lower class homes lacks context and causal relationships and that this leads to deficiencies for the children in various types of problem-solving and conceptual behavior.

In a structured mother-child teaching session, Hess and Shipman (1967) reported specific maternal behaviors which seem to affect the child's learning: 1) prompt maternal feedback was related to the child's learning of the task; task-informing, engaging, and control behaviors were not; 2) the greater the proportion of mothers' messages asking or telling the child to manipulate the blocks, the less likely he is to learn the task; 3) more intelligent mothers use fewer physical commands; 4) there is no correlation between maternal intelligence and propensity to use verbal commands or verbal questioning; 5) the use of questioning to evoke verbal information was correlated with maternal intelligence and with the child's learning of the task. Using data from the same population, Brophy (1970) reported that only middle SES mothers consistently engaged in employing an initial orientation to the task; asking the child to focus his attention on the stimuli; or giving preresponse instructions specifying appropriate verbal labels.

The nature of the mother-child interaction characterized by the Hess and Shipman analyses is consistent with Vygotsky's (1962) hypothesis that speech becomes internalized thought. In other words, the foundation of early language, as a function of the mother-child interaction, determines the organization and quality of thought. Luria (1961) suggests that the degree to which this speech has been internalized can be indexed by the extent to which a child seeking help from adults makes use of this help; i.e., how the child applies the results to his independent activity thereafter. Vygotsky (1962) reported a study in which the children were given a simple task of tracing a picture with a specified pencil. The task is then made more difficult by taking away the pencil. Children from three to four resorted to asking an adult for aid, while the children five to seven years of age tried to find a solution which was, essentially, verbally based: they had an outburst of active speech, intended to verbally orient themselves to the problem situation. However, between the ages of six and eight, what was once unattached, unfocussed speech disappears, because speech has been internalized and now is an integral part of thought, recurring only in difficult situations.

There is additional experimental evidence supporting the hypothesis that the mother structures the cognitive environment of the infant and child. Uzgiris (1968) cites a study by Wachs, Uzgiris and Hunt (1967) in which there were significant differences found favoring middle class infants in the use of objects as a means, in foresightful behavior, and in verbal facility and the attainment of object permanence. Kagan (1968) reports that the number of changes in the activity during free play periods made by lower class infants decreased between the ages of eight to thirteen months while it increased during the same period for middle class infants. He hypothesized that the low SES mothers may discourage exploratory behavior through non-response.

Not only is the content of the verbal exchange between mother and child of importance, but also important is the nature and contingencies of reinforcement utilized by the mother for affecting the child's behavior. Zigler (1963) found that whereas information about the correctness of the problem was more effective for middle SES children, praise was more reinforcing for lower SES. Brophy (1970) found that the degree of informational specificity in maternal teaching patterns is related to SES and the situation: low SES mothers were more specific in post-response than in pre-response feedback and more specific in correcting errors than in confirming correct responses. These authors, Brophy, Hess and Shipman, all conclude that the major class difference seems to be in the facility of attaching meaning to situations and of structuring relatively unstructured situations. Low SES mothers, on the other hand, deal more effectively with the correcting, suppressing or eliminating of undesired behaviors. Their critical problem is in relating the essence of a task, or the desired or appropriate response sufficiently to the context in which it occurs -- to the goals or purpose.

Conceptual tempo is the time taken by a subject to consider alternative solutions before committing himself to one, in a situation of high response uncertainty. Low SES Ss tend to be impulsive, and their performance is characterized by short response times and high error rates. The reflectives, in contrast, have longer response times and lower error rate. Eye movement measures showed that impulsives ignore two and one-half times as many alternatives per item as do reflectives (Siegelman, 1969). In contrast, reflectives devoted less looks and time to the standard, to the most observed alternative, and to the chosen alternative. These results indicated that the algorithm underlying the behavior differs. Reflectives use an algorithm of comparing alternatives for differences (critical features) and checking the standards rather than using a one to one (template) comparison. In this way, reflectives resemble older children (Gibson, 1969).

Siegelman (1969) attempted to train impulsive children to be reflective by reinforcing a delay period before the response. He found that this was not sufficient, and suggested that it was necessary to train scanning algorithms rather, or attention deployment search paradigms within the delay time.

Early Infant Stimulation

Having established that verbal interaction and early verbal development are important if not necessary to cognitive development and cognitive style (defined as dominant response styles), the next question is the effect of stimulation programs upon such development. It is important to specify the degree of maternal involvement in such programs. Gordon (1969) reports preliminary results from a longitudinal study involving both children and their mothers. His early results indicate more attitude change (internal versus external locus of control) than actual cognitive growth, even though the treatment is training the mothers to teach their children. He also reported that the effect of experimental intervention programs intended to change the behaviors of mothers toward their infants had a stronger effect on mother-daughter pairs than on mother-son pairs.

Klaus and Gray (1970) report vertical diffusion effects of a stimulation program. This is a spread of effect of intervention through the family: an effect which is particularly great when the mother and the target child are both participants in the training program. Early results from Klaus and Gray (1970) indicate that diffusion effects come mainly from the mother. In the group in which only the target child was a participant in the stimulation (a group most similar to our experimental group), word fluency measures for the mothers had not changed.

Our research amplifies the Hess and Shipman findings by comparing stimulation program participants to non-participants who were matched on the basis of SES, chronological age, and maternal intellectual functioning. We have planned a series of studies to examine various aspects of the mother-child interaction.

Study 1 -- Mother-child dyads were placed in a structured teaching situation and the amount of information transmitted and shared was evaluated. Also the specific types of teaching and reinforcing behaviors used during the interaction were described.

Study 2 -- The Home Inventory and the Social Reaction inventory are to be administered to the mothers in the home by a trained interviewer. Some of this data will be used in Study 4: Sex role development as a function of father absence.

Study 3 -- Intellectual functioning is analyzed with emphasis upon the relation of the child's semantic memory development and maternal teaching style.

Study 4 -- Sex role and personality development are evaluated using information from Study 2 to consider the effects of father absence.

Study 5 -- A series of cognitive and interaction measures will be integrated. In a mother-child interaction study which begins two years after the completion of Study I, the feedback effects from the children to the mothers are investigated. In addition to the structured mother-child interaction session, a series of cognitive tasks will be administered to the individual children.

The results of these studies will present an integrated picture of the child's cognitive and social development. (See Figure 32) In conceptualization, the dynamic feedback loop between the mother and the child represents how the amount of responsive behavior and the conceptual styles both contribute toward determining the nature of the interaction.

Information Transmission in the Mother-Child Dyad

The present study was concerned with the evaluation of the effects of mother-child interactions. Specifically the study attempted a measure of the information transmission involved in the teaching and interaction patterns of low SES mothers with their preschool-age children. Feedback between the mother and child; types of controls, reinforcements, and teaching methods employed; the situation in which employed; and the response patterns are also considered. An information transmission analysis (Attneave, 1959) was used in addition to percentage measures.

It was expected that the following differences would be found between the teaching and interaction patterns of the experimental parent-child dyads and the controls:

1) the Experimental children would share more information with their mothers than the Controls

2) the Experimental children would enact more verbal behaviors than the Controls or the mothers of either group.

3) there would be less equivocation of information between the Experimental mothers and children than the Controls: given a certain stimulus behavior, the uncertainty of the response would be less

4) the Experimental children would have high task completion scores

5) the Control children would enact more physical than verbal behaviors

One further hypothesis is based upon the nature of the ongoing experimental and control groups. Since these two groups were randomly placed from a population living in the inner city of a large urban center, and since the participants were all matched on the basis of maternal and older sibling IQ, differences observed between the two groups are treatment effects: directly or indirectly. In order to study the possibility of a feedback loop established between the mothers and children of the experimental group, the children who are at the stimulation center eight hours a day, five days a week, contrasted to the controls who spend all their time at home, a further hypothesis is made. The question is whether the increased verbal facility of the experimental group has caused a concurrent increase in the mothers. If this were the case, the Experimental mothers would have a greater amount of verbal behavior, and possibly a higher level of general behavior than the controls. In addition there might be a greater amount of shared information between the Experimental mother-child dyads.

Method

Subjects

The subjects in this experiment were the children over 18 months of age

(N = 27) involved in the Family Rehabilitation Project. The children participating in the daily program are referred to as the Experimental group (E); the other children are the Control group (C), and have not participated in the daily stimulation program and are merely being tested periodically.

Procedure

Mother and child were brought to the research center where a specially prepared room was employed. The mother and child were seated at a table and the task was explained to the mother. Instructions concerning the tasks were given by the Experimenter, who retired to another room where she could observe the mother and child (hereinafter referred to as the dyad: Experimental and Control).

The following tasks were included:

(1) First, the mother was asked to tell her child a story based upon the lion card of the Children's Apperception Test (Hess, 1968). Sentence length, syntactic structure, content and abstraction (proportion of abstract nouns and verbs in relation to the total number of nouns and verbs used), will be measures of the mother's language facility.

(2) Secondly, the mother was told to teach the child the following two tasks: (1) sorting a number of blocks by color and/or by form, (2) the mother teaching the child to copy three designs on a toy Etch-A-Sketch. Rating categories included verbal and physical behavioral action analysis (after Caldwell, 1968) control and reinforcement contingencies, and teaching method. Particular emphasis was upon orienting and motivating stimulation and specific task responding. Information theory analysis was performed to determine the stability of response patterns and the relation between maternal stimulation and the child's responding. In addition, the parent's behavior toward the child, the child's cooperation, affection, and level of achievement with the help of the parent are noted. From these ratings, the dimension of interactions in the home can be more thoroughly evaluated.

A third part of the study will be the administration of a sorting task to the mother. After the task, she is asked to give her reason for putting certain figures together (Kagan, Moss, and Sigel, 1963). The task is intended to reveal her typical or preferred manner of grouping stimuli and the level of abstraction that she uses in perceiving and ordering objects in the environment. Responses are (1) descriptive part-whole; (2) descriptive global; (3) relational-contextual; and (4) categorical-inferential. Through the use of this sorting task, it is therefore possible to determine the preferred style of categorization, and relate it to the child's.

A video-tape recording was made of the entire session by means of a video camera behind a one-way mirror. A microphone was placed on the table where the mother and child were working and the entire session was recorded. In the analysis procedure, sound and vision were synchronized for the raters.

The Rating Scale

The scale was developed after Caldwell's (1969) categorization and rating system for naturalistic observations, and was adapted to a structured situation along the lines of the Hess and Shipman (1965) scale. Ratings are based on a digital system, compatible with computer analysis. The first digit referenced the mother or the child. The second and third digits referred to the behavioral predicate. Therefore, each rating was a string of three digits.

Caldwell (1969) reported 99% reliability when any extra clauses coded by one observer are eliminated and agreement is compared on only those units coded by both persons. On the other hand, however, when eliminating all ratings is considered, inter-rater agreement concerning the subject is 65%, the predicate, 55%.

The behavioral observations were made at the level of the "molar behavioral act" (Tolman, 1932). The ratings were made by two trained raters: male graduate students. Ratings were based on a digital subject-action categorization system. Action was active-passive and physical-verbal (see Appendix II for the full rating scale).

Information Theory Analysis of Data

The preliminary analysis for these sessions between mother and child has been directed toward evaluating the amount and nature of information transmitted and shared between the mother and child of each group. The raw data is a frequency count of the types of responses observed from the dyad. Each of the rated behaviors was grouped into one of twelve stimulus and twelve response categories (informing teaching; positive verbal feedback [Table 14]).

Table 14

Behavioral Rating Scale Categories

	Stimulus Behaviors		Response Behaviors
1.	informing teaching	1.	supplies verbal information
2.	positive verbal feedback	2.	answers question
3.	negative verbal feedback	3.	requests verbal information
4.	requesting verbal feedback	4.	positive verbal feedback
5.	control	5.	negative verbal feedback
6.	requesting physical feedback	6.	nonverbal response visual
7.	physical info-teaching, nonverbal	7.	manip. nonverbal response
8.	positive physical feedback	8.	response to physical feedback request
9.	negative physical feedback	9.	negative physical feedback
10.	ignores	10.	ignores
11.	passive nonteaching behavior task related	11.	task related physical nonperformance passive
12.	nontask related behavior	12.	nontask related

Each two events (mother-predicate, child-predicate) was considered one sequence: one stimulus, one response. Then Attneave's (1959) information theory analysis was applied (see Appendix I to this section).

Results

The information transmission analysis revealed the Experimental mother-child dyads shared more information than the Control dyads (see Figure 32a). The Experimentals also had less "equivocation of transmission": given a certain stimulus there was less uncertainty concerning the response elicited. The children of both groups exhibited more general behaviors than the mothers of either group, with no significant difference between the Experimental and Control children in general behavioral emission level.

Experimental mother-child dyads used significantly more verbal-verbal transmissions than controls and significantly less physical-physical interactions than the controls ($p < .01$). In addition, controls had more verbal-physical sequences in which the mother initiated verbally and the child responded physically. (Figure 33) The experimental dyads performed more of the opposite sequences: the mothers initiated a physical behavior, the child responding verbally. Finally, the Control children and mothers initiated more "ignoring" behaviors than the Experimental children or their mothers.

For the Control group there was a significant correlation between task success and IQ ($p < .05$) (see Table 15) while for the Experimentals there was a significant correlation between task success and chronological age ($p < .05$). In addition, the Experimentals achieved greater success on the block sorting task than the Controls ($p < .05$).

Table 15

Performance Characteristics

Group	Child's IQ		Mother's IQ	Child's CA	
	Mean	SD		Mean	SD
Experimental	124.9	13.2	55-70	39.6	2.9
Control	94.3	10.2	55-70	35.8	3.1

	Block Sort Task Time	Block Sort Task Success	Etch-A-Sketch Task Time
	Mean		Mean
Experimental	5.2	1.4	7.1
Control	5.6	1.1	5.3

MOTHER-CHILD INFORMATION TRANSMISSION

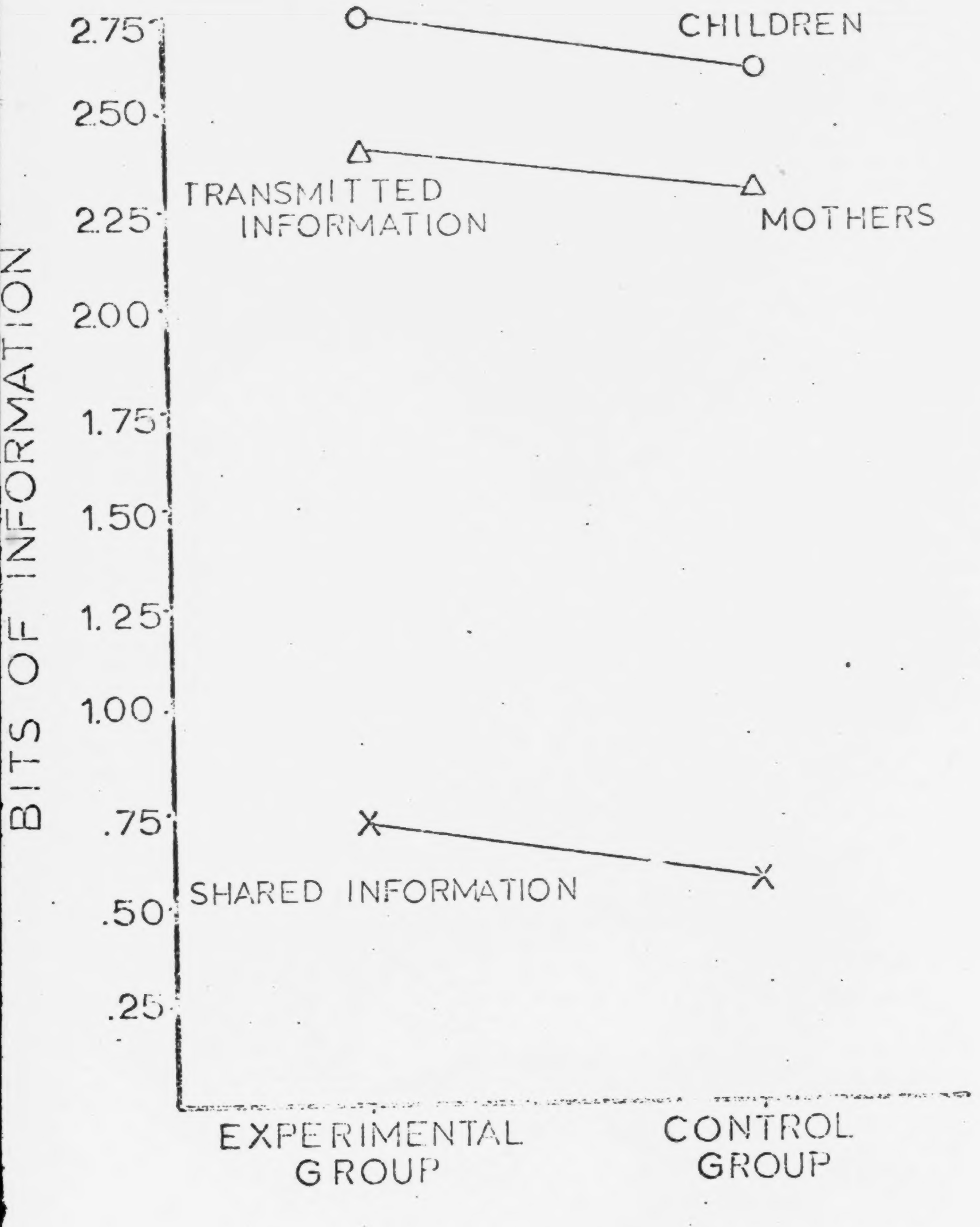


FIGURE 32 α

MOTHER-CHILD VERBAL AND PHYSICAL INTERACTIONS

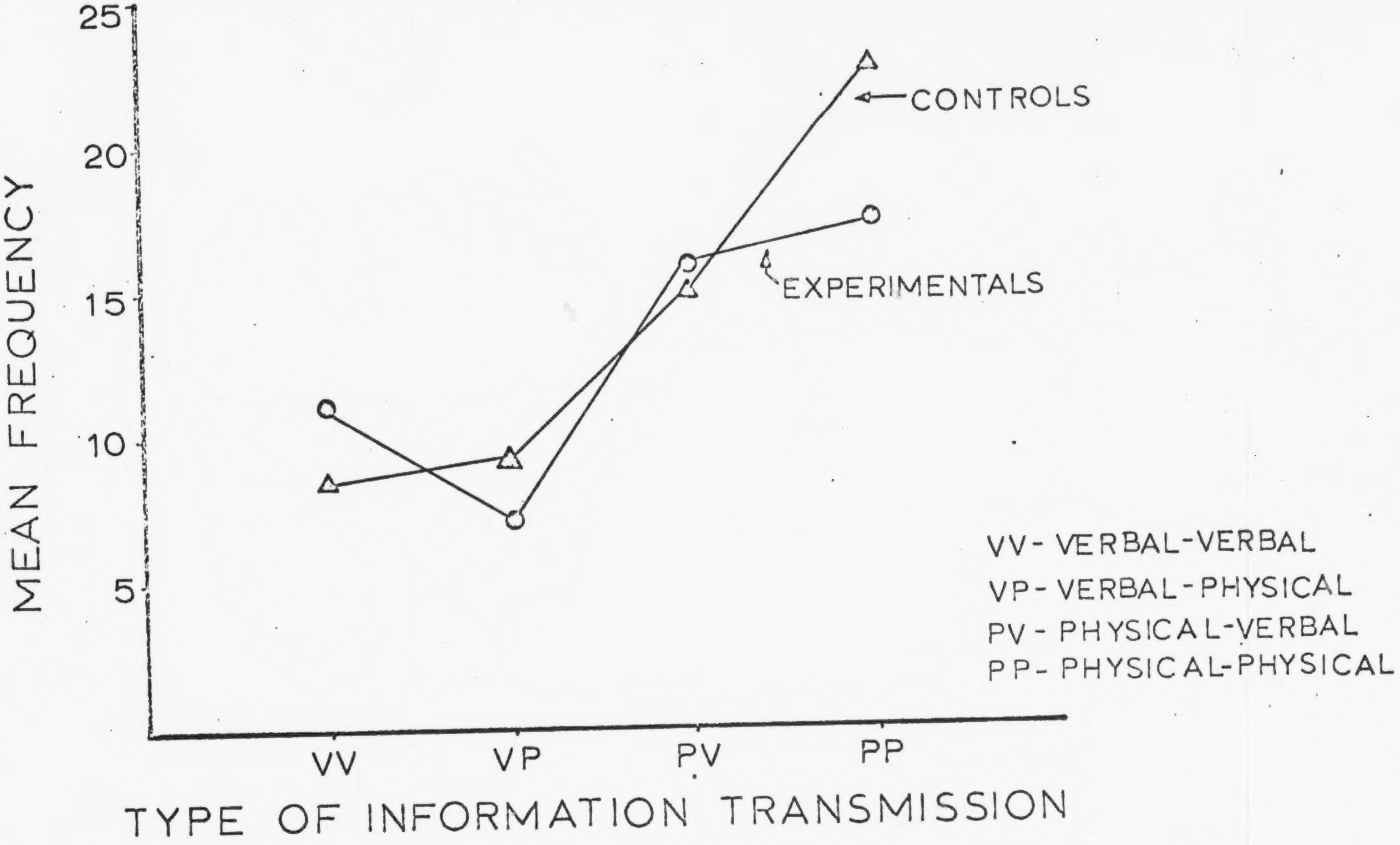


Figure 33

Additional analyses were performed on the specific verbal and physical behavior categories of the data (categories listed in Table 17) as displayed in the performance of the tasks used in the structured situation (i.e. Etch-A-Sketch and block sort). On both tasks Experimental children exhibited a greater amount of verbal behaviors, as compared to the controls who enacted more physical behaviors. (See Figure 34) On the Etch-A-Sketch task, experimental females enacted more verbal behaviors than any other group. In somewhat similar fashion, the control females exhibited more verbal behaviors than control males, but the same number as experimental males. (See Figure 35) Conversely, Control males enacted the most physical behaviors during the Etch-A-Sketch task, followed by Control females and Experimental males. On block sorting, experimental males were the most verbal, followed by control and experimental females. (See Figure 36) And conversely, Control males exhibited the most physical behaviors; experimental males the least.

Category analysis revealed the experimentals used fewer requests for verbal information and positive verbal feedback than the controls on the Block Sort task, but a greater number of all verbal categories (except 4 and 5, unused by both groups) on the Etch-A-Sketch task. A greater number of experimental children supplied verbal information and answered questions than control children during the Etch-A-Sketch task ($t = 1.92$, $p < .1$) and more requests for verbal information and positive verbal reinforcement during the block sorting task ($t = 2.41$, $p < .05$).

There were no significant differences between maternal behaviors on either task (see Table 16) although the Experimental mothers required less time to complete the block sort task than the Control mothers and more time to complete the Etch-A-Sketch than the Control mothers.

Table 16

Maternal Behavior by Task, Category, and Treatment Group of Child

		Category											
		1	2	3	4	5	6	7	8	9	10	11	12
Etch-A-Sketch	Exp.	.08	.05	.04	.04	.10	.05	.11	.03	.04	.01	.38	.06
	Control	.05	.05	.04	.04	.10	.06	.10	.04	.05	0	.36	.05
Block Sort	Exp.	.07	.17	.03	.08	.05	.15	.16	.04	.01	.04	.14	.04
	Control	.06	.16	.04	.05	.05	.21	.15	.04	.04	.01	.12	.07

Table 17

CATEGORIES 1-12

1. Supplies verbal information
2. Answers questions
3. Requests verbal information
4. Positive verbal feedback
5. Negative verbal feedback
6. Nontask verbal behavior
7. Manipulative and visual nonverbal
8. Response to physical feedback request
9. Negative physical feedback
10. Ignores
11. Task related physical nonperformance
12. Nontask physical behavior

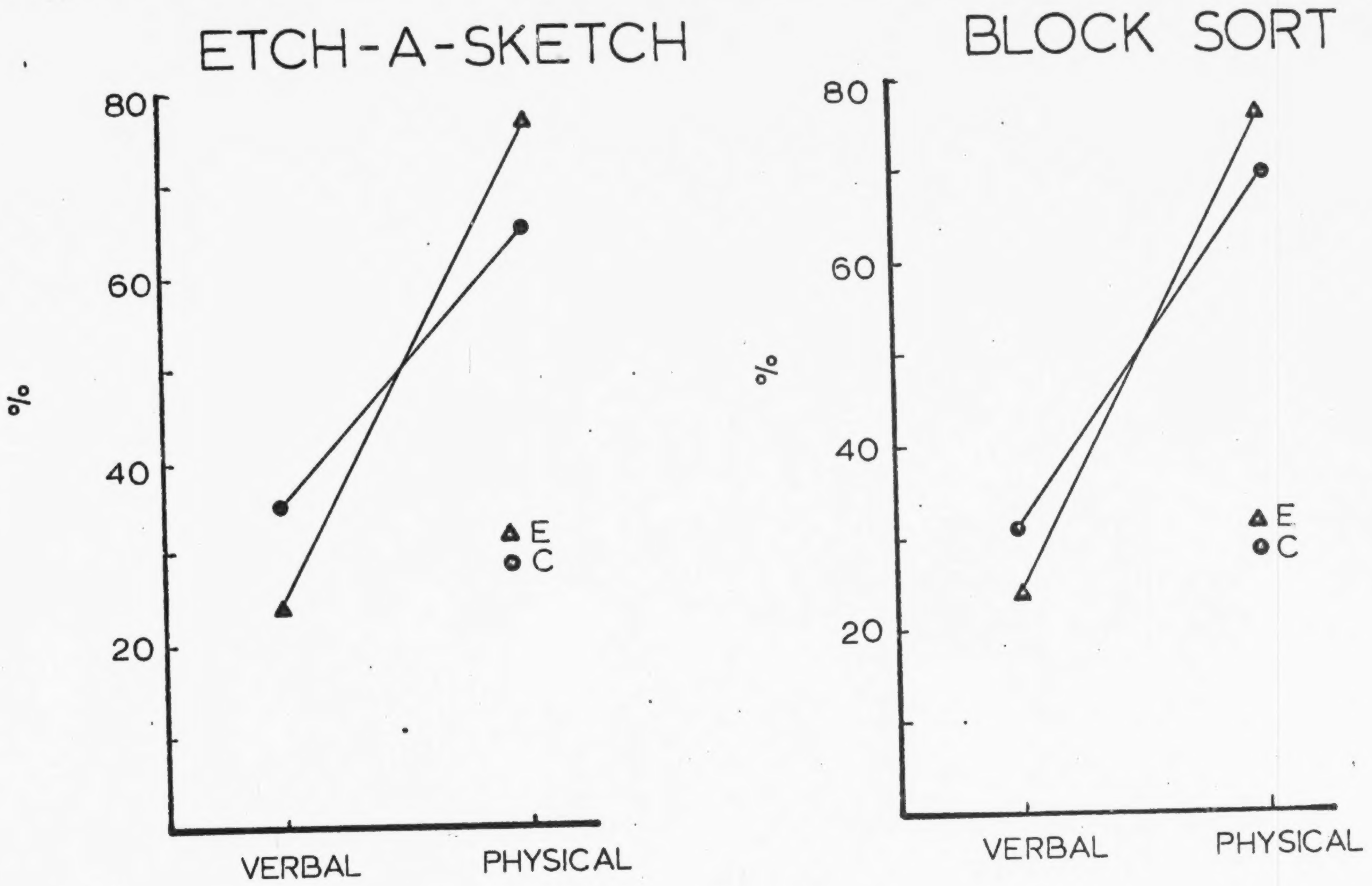
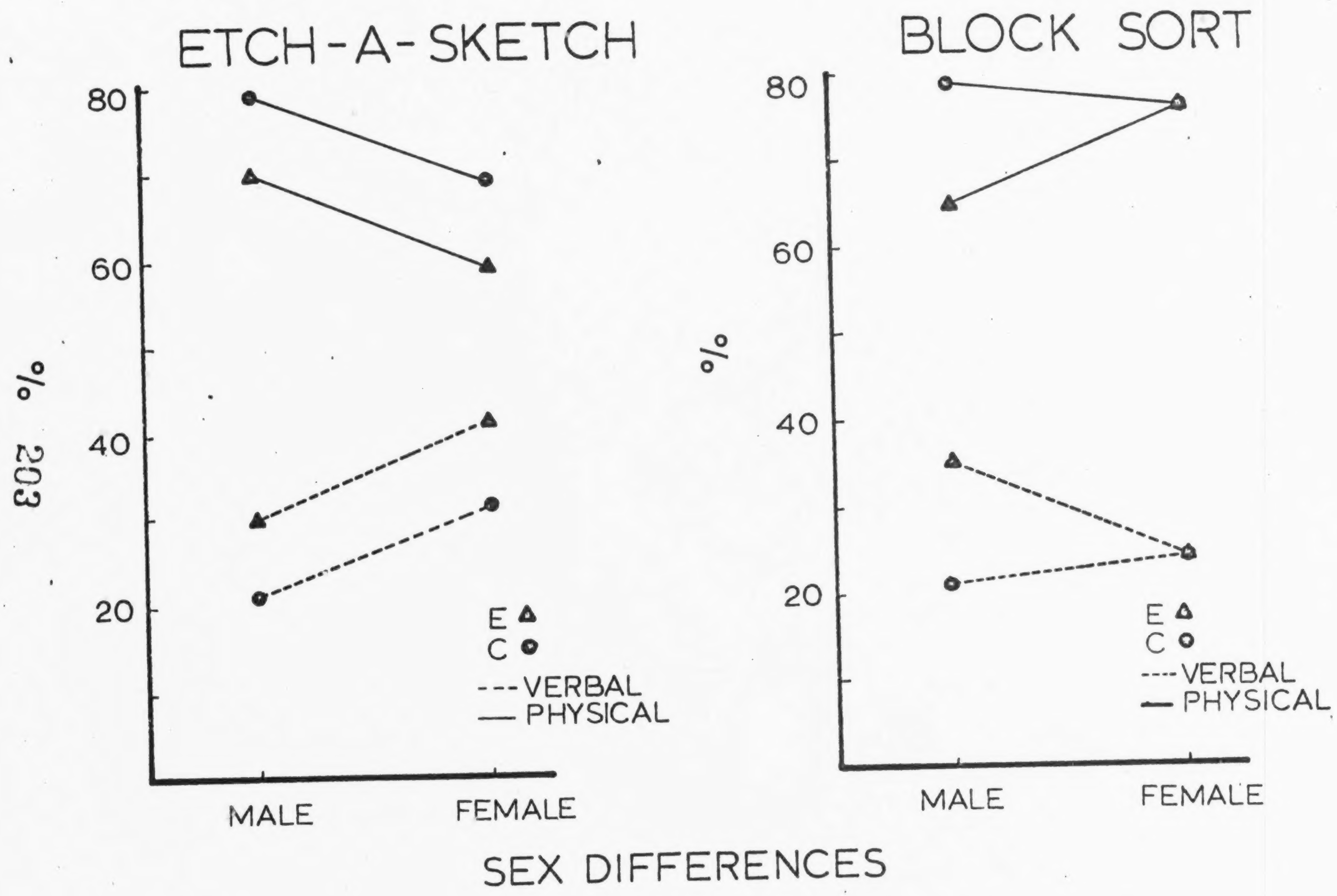


Figure 34

The Percentage of Verbal and Physical Behaviors as a Function of Treatment Group (Experimental-E and Control-C) and Task

Figure 35

The Percentage of Verbal and Physical Behaviors as a Function of Sex, Group, and Task



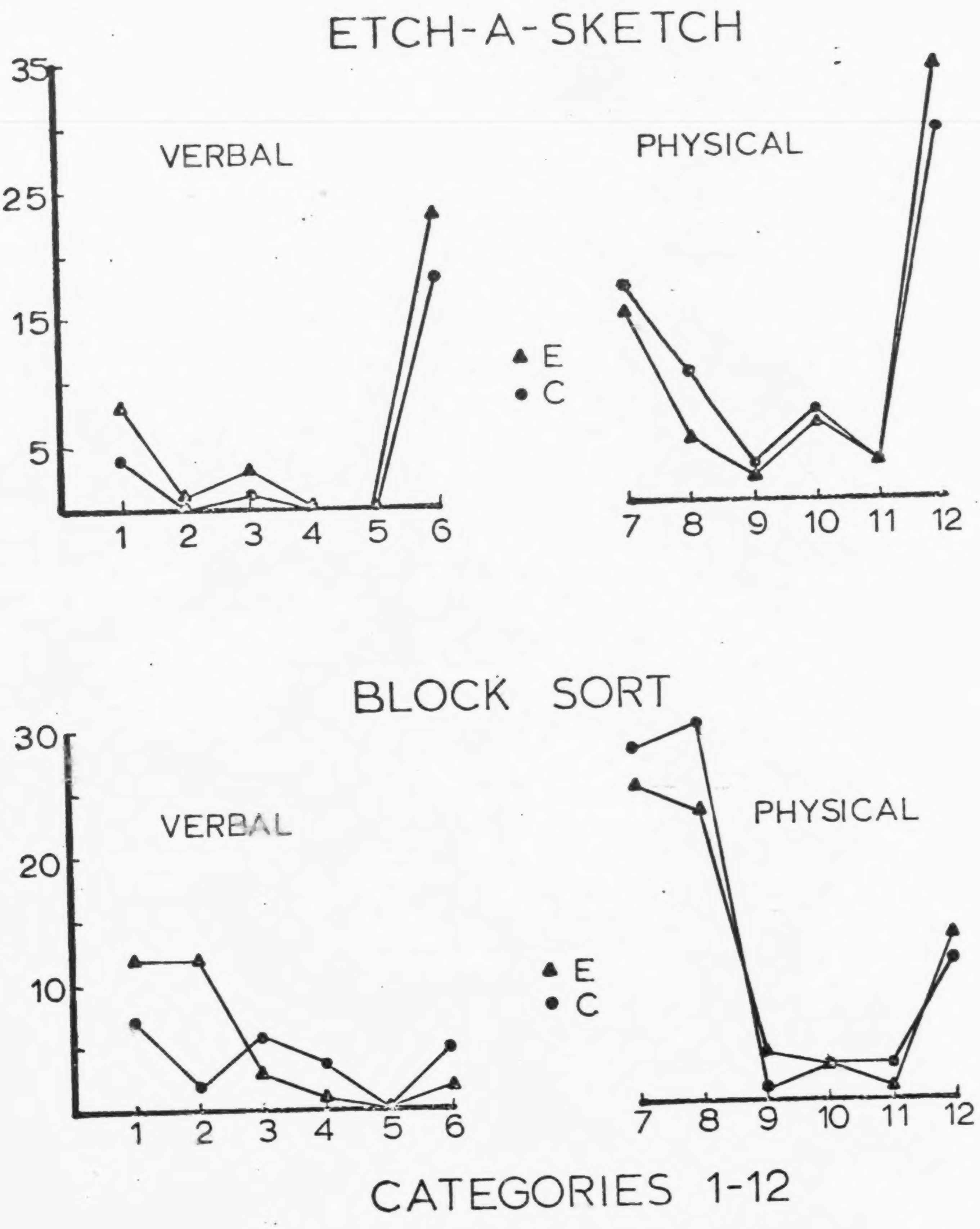


Figure 36

Types of Verbal and Physical Behaviors as a Function of Category, Treatment Group and Task

Discussion

The results confirmed the prediction that the Experimental dyads would share more information than the Controls. The Experimental mothers and children had less equivocation of information: given the stimulus (maternal behavior) there was less uncertainty of the [child's] response. In other words, there was better coordination of stimulus and response by the Experimental dyads: to each maternal stimulus, overt (verbal) or covert (physical), there was a more stable response pattern by the child.

Although it was expected that the Experimental children would transmit more information than the Controls, the results revealed the children of both groups transmitted more information (but not a significantly different amount themselves) than the mothers of either group. Considering this is light of the greater amount of shared information among the Experimentals, it would seem that the children of the Experimental dyad are primarily responsible for the communication enacted between themselves and their mothers. Indeed, since there is no significant difference in the amount of information transmitted by the mothers, it must be the quality of the child's responses which determines the information communicated. The preschool program participated in by the Experimental children has stresses general language development. The emphasis has been directed particularly to the development of expressive verbal behaviors. These behaviors seem to have generalized, since they appear not only in the daily school situation, but from this evidence, appear in the home mother-child interactions. The possibility that generalization effects are the beginning of a feedback loop between the Experimental mothers and their children may be evidenced by the slight difference in the amount of verbal teaching by the Experimental mothers.

Further support for the effectiveness of the program is the superior performance by the Experimental children on the block sorting task. The results of the percentage analysis gives some support to the results of Hess and Shipman's (1967) findings. About one-fourth of the Experimentals' responses were in the verbal categories of supplying verbal information and of answering a question. This was in contrast to the Controls, who had only 10% of their responses in these two categories. Hess and Shipman (1967) point out the importance of verbal information in a teaching situation particularly on the part of the mothers. They found positive correlations among IQ scores of the mother, maternal questioning to evoke verbal information, and child's task success. However, in our study, it appears that the Experimental children themselves were the main force in supplying verbal information and thereby initiated verbal communication. If effect, they verbally oriented themselves in response to mother's covert stimulation. In contrast, the Control mothers would sometimes verbally request behaviors from the child, and the child would respond physically. In Hess and Shipman's (1967) research, they found a negative correlation between task success and direct demands for physical behavior (for a nonverbal response). The Control children did not seem to initiate enough verbal interaction to guide the session, or to respond consistently to maternal behaviors.

Although there were no significant differences in frequency of behaviors by category between Experimental and Control mothers, the Experimental group attempted to evoke verbal behavior from their mothers more than the Controls. This may be related to the demand characteristics of the situation. The children of both groups seemed to have a low expectancy for a verbal response from their mothers. However, the experimentals continued their attempts to evoke responses. In this case the child is acting as the active member of the dyad. "Diffusion" to the mothers (Klaus and Gray, 1970) would be expected to occur in time, if this is a general phenomenon.

Gordon's (1969) observation that intervention programs intended to change the behaviors of mothers toward their infants had a stronger effect on mother-daughter dyads that mother-son. This study revealed a similar phenomenon in that females were more verbal than male children on the Etch-A-Sketch. There is also some indication that Experimental mothers of daughters in our sample were more verbal than mothers of Control daughters.

It is interesting to consider that in contrast to the Experimental dyads, since the children are separated from their mothers for most of their waking hours and have been since they were six months old, the Control dyads spend much time together. Therefore, in light of the results of this study, one might suggest that physical proximity is not necessary for efficient information transmission between mother and child. In fact, a working hypothesis among some researchers has been that lower SES children don't experience the quality of parent-child interaction that occurs in middle class homes. Unlike lower SES mothers, middle class mothers employ considerable fact to face vocalization and smiling; they reward their child's maturational progress, and often enter into long periods of play with the child (Kagan, 1969). Also, it is possible that because the Experimental children talk and express themselves so freely in general, i.e., even at home, that the mothers are beginning to respond in kind. In other words, the Experimental children may be able to structure the information transfer themselves, thereby guiding the mother in the teaching situation. This last possibility was strongly suggested by the data. Further, the child and the mother may be influenced by the unfamiliar setting of the experiment and the unfamiliar demand characteristics evoked between the child and the mother (Figure 32). It is much more familiar for the Experimental child to be confronted by a teacher in a structured learning situation.

In summary, the data strongly suggests that the nature of a preschool educational stimulation program, with its emphasis on language development, facilitated the information transferred in the mother-child interaction among the Experimentals. It was the Experimental children who appear to be responsible for guiding the flow of information, providing most of the verbal information. The mothers of the two groups showed little difference during the teaching session. Instead, the Experimental children's responding led to a greater amount of shared information among the Experimental dyads.

The implications of this study, concerning the generalized effects of a stimulation program upon interpersonal functioning and cognitive development have led to plans for additional studies to clarify and amplify these results. These studies will be concerned with the extent to which the stimulation program has had any effects upon the qualitative home situation (number of books, newspapers, etc.) and upon the aptitudes of the parents or siblings. To quantify information on these questions, an adapted version of the Caldwell home inventory (1968) will be administered to mothers in addition to a version of the Rotter locus-of-control scale (Rotter, 1966).

Planned Research in Social-Personality Development

I. Much of the previous research on parental influence upon the cognitive development of the child has focused upon relatively global data; i.e., child's IQ, SES, and undifferentiated child rearing attitudes or practices. However, the second approach focuses on the specific interaction between the child and the parent and formulates styles and patterns of interaction and control. In our previous research (Falender, Garber, and Heber, 1970) we developed a rating code for mother-child interactions. The subjects were the children from the Experimental and Control groups of our Infant Education Project. During this research, the mothers were instructed to teach their children two tasks. The results revealed a greater amount of information transmitted between the mothers and children of the Experimental group than between the Controls, although it was the Experimental children who used more verbal behaviors than either group, and there were few differences between the mothers of the two groups. We therefore suggested that the Experimental children were mainly responsible for the major part of the information transmission. We also suggested that there could be something like a feedback loop developing between mothers and children of the Experimental group, such that the increased verbal fluency and expressiveness of the children prompts the mother to be more expressive.

Our preliminary findings on the nature of the mother-child interaction and the implications for cognitive development have led to plans for additional correlate studies to clarify and amplify these results. The first question which arises is what, if any, effect has there been upon the mothers of the stimulation group. Our analysis detected a very slight increment in verbal teaching of experimental mothers over the controls. Gordon (1969) reports results from a stimulation program which involves maternal participation. He observed a shift in maternal locus of control from original external locus toward internal orientation. (That they themselves had more control over their environment.) This measure is also correlated to increased verbal behavior of the mother in the home. We intend, therefore, to administer the Social Reaction Inventory used by Gordon (1969) to determine whether such a phenomenon has occurred. (See Appendix II.)

A second concern will be directed toward the specific family variables which influence the quality of mother-child interaction within the low SES population, and which affect the amount of feedback between the Experimental children and their mothers. Tulkin (1968) suggests a matrix of factors which must be used in research with low SES families to prevent confounding. He has presented a paradigm controlling economic level (family income, crowded housing), family milieu (broken homes, family size, birth order, maternal employment), health of the child (prematurity, nutrition, delivery complications) and aspects of parents' own histories (birth order and family size). In contrast to these variables, Dave (1963) reports high correlations between the number of cultural activities participated in by the family as a group and the child's achievement, but such status measures, even the number of books in the home, are not typically found to correlate with the child's achievement.

In order to reassess the nature of the home environment of both the Experimental and Control groups, the Caldwell Home Inventory (1968) (see Appendix III) has been revised and will be administered by a trained interviewer. This interviewer has had much previous contact with the mothers. The results of this inventory will point out any changes which have occurred in the homes over the past few years.

The Home Inventory is divided into nine sections (See Appendix III): 1) organization of a stable and predictable environment, 2) developmental stimulation, 3) quality of language environment, 4) need gratification and avoidance of restriction, 5) fostering maturity and independence, 6) emotional climate, 7) breadth of experience, 8) aspects of physical environment, and 9) play materials.

The data obtained from the Home Inventory and the Social Reaction Inventory will be used to evaluate differences between the Experimental and Control groups and differences within groups as a function of variables such as father absence.

II. The absence of the father and/or father dominance in the mother-father interaction have been identified as the best predictors of the child's sex role identification. The identification, the individual's perception and evaluation of maleness or femaleness, appears to begin with the onset of language mastery at about 18 months, but does not become definitely established until the fifth year (Brown, 1958). The dominance of the father model does not appear to affect the child's sex role preferences, rather the individual's preferential set toward culturally defined sex roles, or sex role adoption, actually derives from observed behavior.

The critical period of effects of lack of a father model upon the child is during the time from 18 months until five years. Hetherington (1966) reported nine to twelve year old father absent boys manifested less masculine projective sex role behavior (on the It Scale for Children) and were rated as more dependent, less aggressive, and as engaging in fewer physical contacts by male recreation directors than father present boys, but only if the fathers' absence began in the first four years of life. Biller (1969) also reported five year old boys who became father absent before the age of four had significantly less masculine sex-role orientations (measured on a fantasy game) than those who became father absent in their fifth year.

The quality and power of the father's presence rather than a frequency count of hours spent near the child are powerful predictors of effects. Hoffman and Salzstein (1967) suggest that concepts of power result in differential modeling on parents of low SES and middle SES children. Strong modeling effects are observed for the middle SES groups, negligible for low SES.

It is hypothesized that during the first five years males tend to identify with a culturally defined masculine role whereas females tend to identify with their mothers (the available model). Because males learn masculine role identification as abstractions from a variety of contexts, they tend to be more field-independent than females and they tend to surpass females in problem-solving skills (Lynn, 1969). However these hypotheses preclude "moderate distance" of the son from the father. In contrast, if the father is distant or absent, boys tend to be field dependent.

A problem with much of the research in this area is the failure to consider age of the child at onset of father absence, length of father absence, and quality of father-mother, father-child interaction patterns across SES level. Often the father absent group is low SES while the comparison group is middle SES, father-present. Low SES father absent children have been reported to suffer from intellectual deficits. Father absent black children in comparison with father-present black children score significantly lower on intelligence and academic achievement tests. Deutsch and Brown (1964) reported father presence to be significantly related to IQ among black subjects in the lower two SES categories. In addition, the black children generally had more negative self-concepts and were more passive and fearful than their white counterparts. Again there are methodological problems of controlling other factors between the two groups.

Turning this problem around, Kohlberg (1966) suggests that differences between father-absent and father-present boys' sex role preferences are considerably lessened if IQ is controlled. He suggests the learning of socially defined concepts of sex role is the primary ingredient of the sex-role development process. Again this points out the methodological problem of family structure upon father-absence. This variable is the determinant between families dependent upon welfare payments for subsistence and the working class. Research has pointed out many subtle distinctions between the two groups which may act as forces equally powerful as father absence, e.g., disorganization, lack of education of mother, external locus of control (Pavenstedt, 1967).

In order to assess the effects of father absence upon the child's sex-role development, intellectual development, and availability for treatment effects, all children will be administered 1) the It scale for children (Bialer, 1961), a projective measure which evaluates sex role identification; and 2) the children's embedded figures test, a measure of field independence-dependence. These measures will be considered in conjunction with information obtained from the Caldwell Home Inventory data collected in proposed study I, including length and age of the child at onset of father-absence.

III. Studies of word association in young children reveal developmental trends. While kindergarteners' responses tend to be syntactically patterned (begin: building a house), children from ages five to ten gradually increase in the number of responses that are paradigmatic, matching the form class of the stimulus. Gradually, the responses tend to converge toward a few high frequency responses (Entwisle, 1970). The existence of paradigmatic responses is interpreted as evidence for the development of semantic structures in children. The child may be developing a semantic map similar to the Collins and Quillian (1969) model, in which response time in a "true-false" choice decision was related to distance between the superset and the property. For example, the sentence "A canary is a bird" would require less "retrieval time" than "A canary has skin." The decision time should vary directly with the number of levels separating memory nodes of the subjects and predicate nominative of the sentence.

Reported social class differences in word association are inconsistent. First grade through third grade slum children are more advanced linguistically than suburban children in that they give more paradigmatic responses. Howeever, the black first graders also give a higher number of nonsense and phonemically similar responses than the middle class children. By the fifth grade, suburban children have a greater response variability, indicating increasing stereotyped responding among the blacks. These results indicate that there may be no great difference in linguistic competence up to age five or six between middle and low SES children. (Entwisle, 1970)

The purpose of the present study is to survey the effects of long term stimulation upon word association responses in contrast to responses made by young children who have not participated in the stimulation project.

Each word, of a list of words, from Entwisle (1970) will be presented singly to a child. The child will be asked to give the first word he or she thinks of in response to the stimulus word. Results will be interpreted as a function of treatment group and developmental status.

IV. As a part of the correlate tasks, the mother-child interaction will be rerun, approximately two years after the original sessions. Several modifications will be introduced into the method. First, the mother will learn the tasks she is to teach the child to a definite criterion. Second, the time interval allowed for task completion will be limited. Third, after the mother has "taught" the child the task, the child will be asked to independently place two additional blocks in their correct piles and to state the principal of placement. The tasks will be modified to include actual Vygotsky blocks, a toy sorting task, and an expanded Etch-A-Sketch task. In addition to this study, it is possible that a comparable interaction could be set up between the children and their teachers (Experimentals); and/or between all the children and strangers--untrained mothers.

A number of additional dimensions of the child's cognitive performance will be considered.

The first analysis will investigate the child's impulsivity-reflectivity dimension (Kagan, 1965). Kagan (1965) described a correlation between analytic sorting style and the tendency to reflect over alternative solutions and to analyze a visual stimulus into component parts. Conversely, the relational style is correlated with impulsivity and nonverbal teaching behaviors. These tendencies are reflected in reaction time measures for a discrimination task. Hess and Shipman (1965) postulate a relationship between an impairment in these reflective patterns and the other areas of functioning in low SES children. Mimbauer and Miller (1970) report significant correlations between IQ and latency of the Kagan (1965) Matching Familiar Figures Test (MFFT), a test designed to measure reflectivity (taking more time to respond and making fewer errors) versus impulsivity. Kagan, Pearson, and Welch (1966) report that the MFFT is correlated with measures of inductive reasoning. Our study will consider the results of the modified children's MFFT and reaction times on the sorting task with reference to these research findings.

As a second part of the impulsivity measures, the Children's Embedded Figures Test (CEFT) developed by Karp and Konstadt (1963) will be administered. These authors report a significant correlation between their measure and the MFFT. Mimbauer and Miller (1970) report that disadvantaged children have more mean errors and shorter mean latencies than "advantaged" Ss. However, covarying out effects of general intellectual functioning eliminated this SES effect.

Next, the Motoric Inhibition Test (MIT) devised by Maccoby, Dowley, Hagen and Degerman (1965) will be used to test the hypothesis that restricted experience with verbal behavior control commands has consequences for the low SES child (Gray and Klaus, 1965). The modified MIT consists of three subtests: 1) the child is shown a paper with pictures of two telephone poles approximately 11 inches apart, connected by a wire, and asked to draw another wire between them. When he completed this, he was given a second sheet and asked to draw the line as slowly as he could. 2) He was asked to crank a toy car hooked to the end of a 30-inch string on the winch of a toy wrecker-truck and then to crank it as slowly as he could. 3) The S is asked to walk between 6-foot long lines placed five lines apart and then walk as slowly as he could.

Mimbauer and Miller (1970) report no significant differences between SES groups of five year olds in inhibition of these behaviors upon verbal request. They hypothesize that ability to inhibit motor response in children under five is related to intellectual performance; after five, most children can inhibit motor responses. Our sample can test this hypothesis.

All of these measures will be placed in a design in such a way as to consider for the following factors (from information obtained during the parental interview):

1) intact versus broken family
2) family size
3) maternal employment (full-time, part-time, not at all)
   (night shift, day shift)
4) birth order of target child
5) birth order of mother
6) mother's family size
7) treatment effects

APPENDIX I

Information Analysis

The sum of $\log_2$ of the total frequency of each of the twelve stimuli (H_x), and the sum of the $\log_2$ of the total frequency of each of twelve responses (H_y) and the sum of the $\log_2$ of each of the frequencies within the 12 x 12 matrix ($H_{x,y}$) are then computed, for each subject. The maximum total amount of information contained in the stimulus and response is 2.58 ($\log_2$ 12). The measure is then subjected to the null hypothesis:

1) The frequencies from which H is calculated deviate only randomly from uniformity (the probability of occurrence of each is equal to all others).

2) There is no relationship between the stimuli and the responses: any response is equally likely to occur to any stimulus -- the child does not respond in "predictable" patterns to maternal stimulation.

If the stimuli indeed have no stimulus (mother) relation to responses, then

$$H(x) + H(y) = H(x, y)$$

$$T(x, y) = H(x) + H(y) - H(x, y) = 0$$

T(x, y) represents the amount of shared information: the amount transmitted from the stimulus to the response. If there were perfect transmission (each stimulus evokes its own response) then

$$T(x, y) = H(x) = H(y) = H(x, y)$$

There is a second category of calculations which represents the "equivocation" of transmission: the uncertainty of the stimulus when the response is known (Hy[x]), and the uncertainty of the response, given the stimulus (Hx[y]). This component may be considered the irrelevance or "noise" component of response information.

$$Hy(x) = H(x,y) - H(y) = H(x) - T(x;y)$$

$$Hx(y) = H(x,y) - H(x) = H(y) - T(x;y)$$

Several features of this analysis should be clarified. First, the measures deal only with the amount of information -- not with the actual information (content). Second, the measure of T is independent of direction or causal relationships: more precisely what is represented by T is association.

APPENDIX II

SOCIAL REACTION INVENTORY

Instructions

This is a questionnaire to find out the way in which certain events in our society affect different people. Each question has two choices, called a or b. Please choose the one of each pair (and only one) which you more strongly believe to be the case as far as you are concerned. Be sure to select the one you actually believe to be more true rather than the one you think you should choose or the one you would like to be true. This is a measure of personal belief; obviously there are no right or wrong answers.

For each question, after I read both remarks to you, put a circle around a if you believe remark a more strongly; put a circle around b if you believe remark b more strongly. After each question tell me when you have made your choice. Then I will read the next one. Feel free to ask me to read any question over again. Be sure to print your name and other information asked for at the top of the page. Please do this now.

In some instances you may discover that you believe both remarks or neither one. In such cases, be sure to select one you more strongly believe to be the case as far as you are concerned. Also try to respond to one question at a time when making your choice; do not be influenced by your previous choices. REMEMBER, in each case, choose the remark which you personally believe to be more true.

SOCIAL REACTION INVENTORY

Parent Name____________________________ City______________________

Child's Name________________________________ Date______________________

Child's Teacher__________________________ Collected By__________________

I More Strongly Believe That:

1. a. Children get into trouble because their parents punish them too much.

   b. The trouble with most children today is that their parents are too easy with them.

2. a. Many of the unhappy things in people's lives are partly due to bad luck.

   b. People's troubles result from the mistakes they make.

3. a. One of the biggest reasons why we have wars is because people don't take enough interest in government.

   b. There will always be wars, no matter how hard people try to prevent them.

4. a. In the long run people get the respect they deserve in this world.

   b. It is the sad truth that an individual's worth often passes without being recognized no matter how hard he tries.

5. a. The idea that teachers are unfair to students is "hot air."

   b. Most students don't realize how much their grades are influenced by accident or chance.

6. a. Without the right breaks one cannot be a good and able leader.

   b. Able people who fail to become leaders have not taken advantage of their opportunities.

7. a. No matter how hard you try, some people just don't like you.

   b. People who can't get others to like them, don't understand how to get along with others.

8. a. What a person is born with plays the biggest part in determining what they are like.

   b. It is one's experiences in life which determine what they are like.

9. a. I have often found that what is going to happen will happen.

b. Putting trust in fate has never turned out as well for me as making a plan to take a certain course of action.

10. a. In the case of the well prepared student there is hardly ever such a thing as an unfair test.

b. Many times test questions tend to be so different from class work, that studying is really a waste of time.

11. a. Becoming a success is a matter of hard work, luck has little or nothing to do with it.

b. Getting a good job depends mainly on being in the right place at the right time.

12. a. The average citizen can have an influence in government plans.

b. This world is run by a few people in power, and there is not much the little guy can do about it.

13. a. When I make plans, I am almost certain that I can make them work.

b. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad luck anyhow.

14. a. There are certain people who are just no good.

b. There is some good in everybody.

15. a. In my case, getting what I want has little or nothing to do with luck.

b. Many times we might just as well decide what to do by tossing a coin.

16. a. Who gets to be the boss often depends on who was lucky enough to be in the right place first.

b. Getting people to do the right thing depends upon being able, luck has little or nothing to do with it.

17. a. As far as world affairs are concerned, most of us are pushed around by forces we can neither understand, nor control.

b. By taking an active part in government and social affairs, the people can control world events.

18. a. Most people don't realize the point to which their lives are controlled by accident and chance.

b. There is really no such thing as "luck."

19. a. One should always be willing to admit his mistakes.

    b. It is usually best to cover up one's mistakes.

20. a. It is hard to know whether or not a person really likes you.

    b. How many friends you have depends upon how nice a person you are.

21. a. In the long run the bad things that happen to us are made up for by the good ones.

    b. Most troubles are the result of lack of know-how, lack of knowledge, being lazy, or all three.

22. a. With enough effort we can clean up dirty government.

    b. It is difficult for people to have much control over the things government leaders do in office.

23. a. Sometimes I can't understand how teachers arrive at the grades they give.

    b. The harder I study the better grades I get.

24. a. A good leader expects people to decide for themselves what they should be.

    b. A good leader makes it clear to everybody what their jobs are.

25. a. Many times I feel that I have little influence over the things that happen to me.

    b. It is impossible for me to believe that chance or luck plays an important part in my life.

26. a. People are lonely because they don't try to be friendly.

    b. There is not much use in trying too hard to please people -- if they like you, they like you.

27. a. There is too much emphasis on athletics in high school.

    b. Team sports are an excellent way to build character.

28. a. What happens to me is my own doing.

    b. Sometimes I feel that I don't have enough control over the direction my live is taking.

29. a. Most of the time I cannot understand why politicians behave the way they do.

b. In the long run, the people are responsible for bad government on a national as well as on a local level.

Adapted by Larry M. Bilker, Institute for Development of Human Resources, College of Education, University of Florida, Gainesville, Florida 32601, from the Rotter I-E Scale.

APPENDIX III

Name of child participating in program ______________________________

Person giving information in interview (specify relationship) ___________

____

HOME STIMULATION INVENTORY

Mother's name __________________________ Date of interview _________

Father's name ___________________________

Address ____

Phone no. ____________________ Type of dwelling _____________________

Children in family ____
(Specify sex and age--B3, G1 1/2)

List child	age	sex

Others living or working in household

Name	age	sex	occupation

Amount of contact these others have with child involved in program

____

Father Occupation	approx. age	educ.	eth.	Mother Occupation	approx. age	educ.	eth.
Currently employed	Yes No	Hours/Week _____		Currently employed	Yes No	Hours/ Wk _____	

Persons present in home during visit ___________________________________
(If other than those mentioned above, please specify name, relationship, age)

Time visit began _________ Time visit ended _________ Interviewer ___________

Comments:

YES NO

Daily Living

1. Mother is principal caretaker of the child
   If NO
   a. primary care is by one or more sibs
   b. primary care is by one of three regular substitutes
   (name them)____________________________
2. Father or father figure is present in home at least four days a week
   Meals
   Mother eats Breakfast____, Lunch____, Dinner____ with the child
   Father eats Breakfast____, Lunch____, Dinner____ with the child

   Mother prepares meals
   If NO
   sibs prepare meals
   each prepares his own meal
   one person is responsible for preparing meals (please specify)
   ____
   There are organized structured meal times for the family group
   Child uses a regular (full-size) fork and spoon
   Action is taken if the child spills food, drink
   Child must eat what is given him
   Child is expected to feed himself
3. Dressing
   Child is expected to dress self regularly
   to put his clothes on
   to tie his own shoes
   Child is responsible for self-care routines (feeding self, teeth brushed, washing self)
4. TV
   Family has a TV (specify number) ____
   TV is on continuously daily
   TV is on during interview
   If YES rate loudness: very loud_____ , medium______, low _______
   Child is required to be quiet when TV is on
   Everyone is quiet when TV is on
   TV preferences
   a. children's shows
   b. game shows
   c. dramas, stories, movies
   d. news, sports events
   e. no preference
   f. others ____________________
5. Parental interaction with child
   1. parent often plays games with child, makes up stories, plays "house"
   2. parent sings to or with child
   3. child is encouraged to learn songs, TV commercials, nursery rhymes
   4. Motor development of child is encouraged (climbing, riding tricycle, motor games)

YES NO

a. Child is allowed unlimited playtime outside
b. Child must be inside by ___o'clock at night
5. Child plays around the house, streets, alleys
6. Child has access to playground with equipment
a. climbing -- jungle jim, bars
b. swings
c. slides
d. sandbox
6. Child spends more than three hours per day playing outside.
7. Punishment: child is punished physically (spanked, slapped...) at least once a week
a. One person is responsible for punishment of child
If NO
b. three people are responsible for punishment
specify names and relationships____________
____
c. Punisher explains reasons for punishment to child
d. Parent sets limits for child and generally enforces them -- time limits, things the child is not allowed to do, specific punishments for specific acts
e. Parent allows the child to hit him
8. Family goes places together, regularly
a. church
b. shopping
c. out of town
d. entertainment -- movies, etc.
9. Pets -- the family has one or more pets
a. one person is responsible for care of pet
10. The household subscribes to at least one magazine
(specify --________________________)
11. Household subscribes to a daily newspaper
12. A bookshelf with at least ten books is present

Play equipment available in the home
1. There is play equipment available in home.
a. equipment is not broken, extremely dirty
b. equipment (toys) are appropriate for the age group of the child
c. Toys are
1. manipulative (blocks, building, puzzles)
2. learning oriented (letters, numbers, books)
3. small toys (trucks, dolls, cranes)
4. rhythm toys (instruments, shakers, horse rocker)
5. record player and five children's records

Observations to be made by interviewer during home visit
1. The mother initiates verbal interchange with the visitor: asks questions, makes spontaneous comments
2. The mother sets up a situation that allows child to perform or "show off" during visit

	YES	NO
3. Mother does not interfere with child's actions or restrict child's movements more than three times during visit		
4. Mother uses correct grammar and pronunciation		
5. Mother's speech is distinct, clear, audible		
6. Child is not punished or ridiculed for speech		
7. Mother talks to child at least twice during visit -- not counting scolding		
8. Mother usually responds verbally to child's talking		
9. Mother makes effort to provide something for child to do during the interview		
10. Mother focuses on child, not on her own problems during visit		
11. Mother introduces interviewer to child or in some way makes interviewers presence known to child		
12. Mother does not shout at child during interview		
13. Mother does not slap or spank child during visit		
14. Mother does not use physical restraint, shake, grab child during the visit.		
15. Mother spontaneously praises child during interview		
16. Interior of house, apartment is not dark		
17. Rooms are not overcrowded with furniture		
18. Rooms are not barren of furniture, empty		
19. All visible rooms are reasonably clean and minimally cluttered		
20. At least ten books are present and visible in the apartment		
21. Mother holds child in her lap at least five minutes during interview		

BIBLIOGRAPHY

Appel, M.H. Aggressive behavior of nursery school children and adult procedures in dealing with such behaviors. J. Exp. Education, 1942, II, 185-199.

Attneave, Fred. Applications of Information Theory to Psychology. New York: Holt, Rinehart and Winston, 1959.

Bernstein, B. Language and social class. Brit. J. Sociology, 1960, 11, 271-276.

Bialer, I. Conceptualization of success and failure in mentally retarded and normal children. J. Personality, 1961, 29, 303-320.

Biller, H.B. Father absence, maternal encouragement and sex role development in kindergarten-age boys. Child Devel., 1969, 40, 539-546.

Body, M.K. Patterns of aggression in the nursery school. Child Devel., 1955, 26, 3-11.

Bronfenbrenner, U. Socialization and social class through time and space. In E. Maccoby (Ed.) Readings in Social Psychology. New York: Henry Holt, 1958, 400-425.

Brophy, J.E. Mothers as teachers of their own preschool children: The influence of SES and task structure on teaching specificity. Child Devel., 1970, 41, 79-94.

Brown, D.G. Sex role development in a changing culture. Psych. Bull., 1958, 54, 232-242.

Caldwell, B. Inventory of Home Stimulation. Mimeo, Syracuse University, Children's Center, 1968.

Caldwell, Bettye M. A new approach to Behavioral ecology. In J.P. Hill (Ed.) Minnesota Symposia on Child Psychology, Vol. 2. Minneapolis: University of Minnesota Press, 1969, 74-110.

Collins, A.M., and Quillian, M.R. Retrieval time from semantic memory. J. Verbal Learning and Verbal Behavior, 1969, 8, 240-247.

Dave, R.H. The identification and measurement of environmental process variables that are related to educational achievement. Unpublished Ph.D. Dissertation, Univ. of Chicago, 1963.

Davis, A., and Havighurst, R.J. Social class and color differences in child rearing. American Sociol. Rev., 1946, 11, 698-710.

Deutsch, M., and Brown, B. Social influences in negro-white intelligence differences. J. of Social Issues, 1964, 20, 24-35.

Entwisle, D.R. Semantic systems of children: Some assessments of social class and ethnic differences. In F. Williams (Ed.) Language and Poverty. Chicago: Markham, 1970, 123-139.

Falender, C.A., Garber, H., and Heber, F.R. Patterns of Mother Child Interaction. Mimeo, University of Wisconsin, 1970.

Gibson, E.J. Principles of Perceptual Learning and Development. New York: Appleton, Century, Crofts, 1969.

Gordon, I.J. Early child stimulation through parent education. Final report to Children's Bureau, Dept. HEW, PHS-R-306, 1969.

Gray, S.W., and Klaus, R.A. An experimental preschool program for culturally deprived children. Child Devel., 1965, 36, 887-898.

Hess, R.D., and Shipman, V.C. Early experience and the socialization of cognitive modes in children. Child Devel., 1965, 36, 869-886.

Hess, R.D., and Shipman, V.C. Cognitive elements in maternal behavior. In J.P. Hill (Ed.) Minnesota Symposia on Child Psychology, Vol. 1. Minneapolis, University of Minnesota Press, 1967, 57-81.

Hess, R.D. Early education as socialization. In R.D. Hess and R.M. Bear (Eds.) Early Education. Chicago: Aldine, 1968, 1-8.

Hess, R.D., and Shipman, V.C. Maternal influences upon early learning. In R.D. Hess and R.M. Bear (Eds.) Early Education. Chicago: Aldine, 1968, 91-103.

Hetherington, E.M. Effects of paternal absence on sex-typed behaviors in Negro and white preadolescent males. J. Pers. and Soc. Psych., 1966, 4, 87-91.

Hoffman, M.L., and Salzstein, H.D. Parent discipline and child's moral development. J. Pres. and Soc. Psych., 1967, 5, 45-57.

Kagan, J., Moss, H., and Sigel, I. Psychological significance of styles of conceptualization in basic cognitive processes in children. Monog. SRCD, 1963, 28, 2, 73-112.

Kagan, J. Reflection-impulsivity and reading ability in primary grade children. Child Devel., 1965, 36, 609-628.

Kagan, J., Pearson, L., and Welch, L. Conceptual impulsivity and inductive reasoning. Child Devel., 1966, 37, 583-594.

Kagan, J. The many faces of response. Psychology Today, 1968, 1, 22-27.

Kagan, J. Inadequate evidence and illogical conclusions. Har. Educ. Rev., 1969, 39, 2, 274-277.

Karp, S.A., and Konstadt. Manual for the Children's Embedded Figures Test. Brooklyn, N.Y.: Cognitive Tests, 1963.

Klaus, R., and Gray, S. Early Training Project: A Seventh Year Report. Mimeo, 1970.

Kohlberg, L.A. A Cognitive developmental analysis of children's sex role concepts and attitudes. In E.E. Maccoby (Ed.) The Development of Sex Differences. Stanford: Stanford University Press, 1966.

Luria, A.R. The Role of Speech in the Regulation of Normal and Abnormal Behavior. London: Pergamon Press, 1961.

Lynn, D.B. Parental and Sex-Role Identification. Berkeley, Calif.: McCutchan Publishing Co., 1969.

Maccoby, E., Dowley, E., Hagen, J., and Degerman, R. Activity level and intelligence functioning in normal preschool children. Child Devel., 1965, 36, 761-770.

Milner, E. A study of the relationship between reading readiness in grade one school children and patterns of parent-child interaction. Child Devel., 1951, 22, 95-112.

Mimbauer, C. and Miller, J. Socioeconomic background and cognitive functioning in preschool children. Child Devel., 1970, 41, 471-480.

Muste, M., and Sharpe, E. Some influential factors in the determination of aggressive behavior in preschool children. Child Devel., 1947, 18, 11-28.

Pavenstedt, E. The Drifters. Boston: Little, Brown, 1967.

Rotter, J.B. Generalized expectancies for internal versus external control for reinforcement. Psych. Monog., 1966, 80, 1.

Sears, R.R., Maccoby, E., and Levin, H. Patterns of Child Rearing. Evanston, Ill.: Row, Peterson and Co., 1957.

Siegelman, E. Reflective and impulsive observing behavior. Child Devel., 1969, 40, 1213-1222.

Tolman, E. Purposive Behavior in Animals and Men. New York: Century Co., 1932.

Tulkin, S. Race, class, family, and school achievement. J. Pers. and Soc. Psych., 1968, 9, II, 31-37.

Uzgiris, I.C. Socio-Cultural Factors in Cognitive Development. Presented at Peabody Conference, 1968.

Vygotsky, L.S. Thought and Language. Cambridge: M.I.T. Press, 1962.

Wachs, T.D., Uzgiris, I.C., and Hunt, J. McV. Cognitive development in infants of different age levels and from different environmental backgrounds. Paper presented at SRCD, New York, March, 1967.

Walters, J., Pearce, D., and Dahms, L. Affectional and aggressive behavior of preschool children. Child Devel., 1957, 28, 15-26.

Zigler, E. Social reinforcement, environment and the child. American Journal of Orthopsychiatry, 1963, 33, 614-623.

VI

MEASUREMENT OF LANGUAGE DEVELOPMENT

Introduction

It is perhaps language facility which most clearly differentiates the "cultural-familial" mentally retarded person from his non-retarded peers. For this reason, great emphasis is being given to contrastive description and analysis of the linguistic development of experimental and control group children. Our concern is both with the quantitative and qualitative differences in the developing language structures of these two groups.

The development of language in the child depends on a number of organic and environmental factors. In the latter case, the main variable in the social environment critical to language development in the child is the adult, particularly the mother. In effect then, children learn language from others in the environment. Brown and Bellugi (1964) have noted three processes which normally appear to be operating in the actual learning of language. The first process is one of imitation with reduction by the child of the adult utterances in the environment. The young child seems to reduce adult utterances to a form which is much like that of a telegram; i.e., it utilizes the high content, low-function words of the adult utterance. Thus, where an adult might say something like, "I see the big chair," the child might say, "See chair." This telegraphic language can communicate a situation known to the adult and the child.

The second process appears to involve the imitation of the child's utterances by the adult. What happened is, when a child says something, the adult repeats the utterance and expands it slightly. The resulting utterance is a perfectly formed model sentence in the adult language which apparently has, as its purpose, the effect of saying to the child, "This is the way you could have said what you just said." Thus, where a child might say something like, "There doggie," the adult might say, "Yes, there is a doggie." This type of imitation occurs in about 30 percent of the utterances.

The third process is one of induction of the latent structure. This requires that the child learn the rule of the language, which he appears to do in some covert manner. The basic learning of the language system is usually complete by the time the child enters school. Our overriding concern is to determine if the various indices of developmental growth in language vary as a function of the experimental program.

Research in developmental psycholinguistics has utilized three measures for determining the level of a child's linguistic development: 1) Imitation--the child's ability to repeat grammatical structures presented to him as models; 2) Comprehension--his understanding of these structures; and

3) Production--his ability to produce the structures himself. Various structured and unstructured test situations have been set up to avail ourselves of these measures. Production has been measured through the use of gross feature tabulation of free speech samples. Imitation has been measured by the use of a Sentence Repetition test and comprehension by the Grammatical Comprehension test. These methods of analysis have been largely developed by the researchers in our language laboratory. Use has also been made of a standardized test of language development, The Illinois Test of Psycholinguistic Abilities. Altogether, the results of these tests provide a comprehensive picture of the language development of the project's children.

THE USE OF GROSS FEATURE TABULATION TO MEASURE LANGUAGE PRODUCTION

Free speech language analysis is generally concerned with the language of children at a very early age. Free speech data, which leads to the identification of developmental trends, is intended to provide information about a child's linguistic ability in unstructured stimulus environments. The child is confronted with an environment in which there are familiar stimulus objects and a familiar person (in this case, the language tester) who is of the same racial and cultural background and with whom the child has developed good rapport. Restricting language performance sampling to structured test situations reduces the validity of measures of grammar and language competence and are not really feasible under three years of age. It is therefore crucial to design an experimental situation that permits the child to manipulate objects that might be common to his own home and daily life settings, yet facilitates the actual sampling of language production.

Current programs designed to encourage and develop language and cognitive abilities have not used free speech analysis as a tool in evaluating developmental language trends. Free speech language data, nevertheless, not only provides a useful summary of the developmental process, it also may suggest qualitative differences between different groups or populations.

Essentially, this kind of language analysis involves the quantification of free speech. The speech of an individual is recorded either through the use of a video-tape machine or a tape recorder. The individual is generally interacting with someone in a relatively unstructured environment. A written language transcription can then be made from this recording of his exact speech. There are several dependent measures of free speech, i.e., to be used in quantification; vocabulary range; length of sentences and total number of utterances.

There are two currently popular methods for systematically investigating vocabulary development: 1) a non-structured observational technique to study productive vocabulary; and 2) a structured method wherein either test materials or specific questioning of the child is employed to arrive at an estimate of recognition vocabulary. There are problems inherent to the use of tests since the test score is derived, i.e., it is obtained by multiplying it by a constant which yields an 'accurate estimate' of total vocabulary size. In comparison, the non-structured observation can yield a fuller recognition and understanding of the rate and timing of acquisition of vocabulary items into the linguistic behavioral repertoire.

Normative studies of grammatical development have typically examined syntactic development through changes in the length and complexity of the sentence. McCarthy (1954) summarizing data from a large number of studies concerned with sentence length found that, in general, the length of the sentence increased steadily through maturity. Cazden (1968), utilizing the free speech analysis method, investigated the acquisition of five noun and verb inflections by three children, and found that the mean utterance length in morphemes in a sentence increased with age.

Therefore, after a careful study of the literature regarding language acquisition, it was felt that we could not afford to disregard free speech analysis as a research technique. This decision considered the extreme economics involved in obtaining these measures. For each free speech sample, upwards of 25 times the time length of the sample is required for its proper transcription. But, as has been pointed out, it is through this technique that a realistic speech sample can be approximated. Free speech samples, we feel, are a very necessary complement to other data being used in the development of a comprehensive picture of language acquisition. Without it, data would otherwise be obtained only by structured, elicitational techniques which can increase cumulatively the number of artifacts entering the data.

Method

A group of 41 children were previously identified as part of a 'high risk' population from the inner-city in Milwaukee. Twenty five of these children compose the experimental group of an ongoing preschool intervention program, directed by the University of Wisconsin. A comparison control group has also been tested simultaneously. The control group has not received any extra stimulation apart from their normal home and living environment, i.e., they do not participate in the preschool program.

Every six weeks, beginning at 18 months, a free speech sample was recorded of both the experimental and control group children. Each session lasted for approximately 45 minutes. In the free speech situation, the experimenter was instructed simply to interact with the children.

The tapes with the sample emissions are then submitted for transcription to specialists with training in applied English linguistics. After each original transcription, the tape and transcript are resubmitted for 'proofing' by another transcriber. In this manner, we have minimized interpretational biases that might otherwise affect the validity of the data. The transcripts for both the experimental and control group children have been analyzed for the following information:

(1) Total Utterances

The total number of utterances, defined as any discernible word or set of words between pauses, were recorded. The number of utterances in any sample was then weighted for length of session by dividing by the length of the session. This yielded a score for the number of utterances per minute which was then weighted by ten for comparison purposes. All other measures were similarly derived so that each score represents a number of emissions of a particular type for a ten minute interval of time.

(2) Total Multi-Word Utterances
(3) Total Single-Word Utterances

The total number of utterances was divided into single- and multi-word utterances to view the suspected differential growth over time. A multi-word utterance was defined as any discernible set of two or more words between pauses.

(4) Total Repetitive Utterances
(5) Total Spontaneous Utterances

The total number of utterances was divided into total repetitive or imitative versus total spontaneous utterances. In the first case, children often imitated something the experimenter said, as contrasted with the spontaneous usage of a unique utterance.

(6) Mean Number of Morphemes in an Utterance
(7) Gross Number of Morphemes

A morpheme was defined as the smallest meaningful unit of speech. 'Book' would be an example of one morpheme while the plural 'books' would be counted as two morphemes. Mean number of morphemes per utterance for each child was averaged within groups. Also, the total number of morphemes produced by each group as a whole was examined.

(8) Vocabulary Range

Each unique response item was counted and similarily weighted as above in the items to derive a score for a ten minute period.

Results

Mean number of total utterances, single and multi-word utterances, spontaneous and repetitive utterances, all indicate a variable frequency rate over time. Total utterances (Fig. 37) for the experimental group increase steadily over the first 12 months of sampling from 3.9 total utterances at 20 months, to 64.9 utterances at 32 months. At 35 months, the total utterances

FIGURE 37

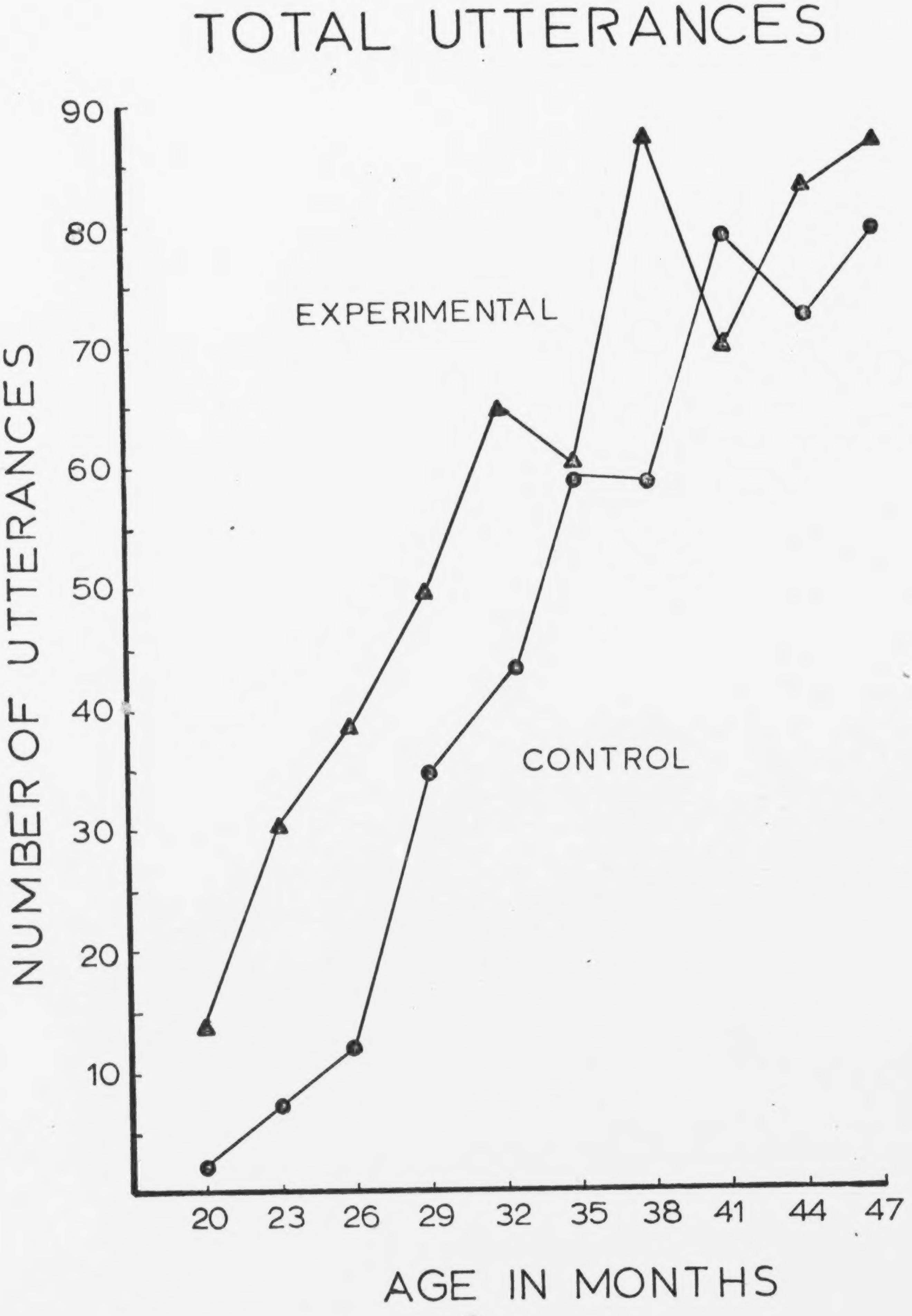

TOTAL UTTERANCES
NUMBER OF UTTERANCES
90
80
70
60
50
40
30
20
10
EXPERIMENTAL
CONTROL
20
23
26
29
32
35
38
41
44
47
AGE IN MONTHS

TABLE 18

TOTAL UTTERANCES

	Age in Months									
	20	23	26	29	32	35	38	41	44	47
Experimentals	13.9	30.4	38.4	49.6	64.9	60.1	87.3	69.6	79.8	86.6
Controls	2.0	7.4	12.0	34.5	43.1	59.0	58.8	79.0	72.1	79.9

decrease to 60.1 for the experimental group, and then rise sharply to 87.3 at 38 months, decreasing again at 41 months and gradually climb over the next six months to 86.6. The control group's curve for total utterances is quite similar to the experimental's though it occurs three months later in development. The mean number of total utterances increases gradually over a 15 month period from 2.0 utterances at 20 months to 59.0 total utterances at 35 months. The curve plateaus at the 38 month period and then increases to 79.0 at 41 months, decreases to 72.1 at 44 months and then slightly increases to 79.9 utterances at the 48 month period.

Total multi-word utterances (Fig. 38) for both the experimental and control groups follow the same trends as the total utterance curve.

TABLE 19

TOTAL MULTI-WORD UTTERANCES

	Age in Months									
	20	23	26	29	32	35	38	41	44	47
Experimentals	5.5	14.5	23.5	36.5	53.6	45.8	69.7	56.4	62.0	67.8
Controls	0.6	2.9	6.5	19.2	27.3	42.8	44.8	59.1	53.5	60.8

The experimental group shows a growth from 5.5 mean number of multi-word utterances at 20 months to 53.6 multi-word utterances at 32 months. The mean number then decreases to 45.8 at 35 months, accelerates to 69.7 at 38 months, decreases to 56.4 at 41 months and slowly steps to 67.8 multi-word utterances at 47 months. The control group, which measured 0.6 total multi-word utterances at 20 months, gradually increases over the next 21 months to 59.1 multi-word utterances at 41 months. The number slightly decreases to 53.5 at 44 months and then jumps to 60.8 at 47 months.

The curves of total mean number of single-word utterances (Fig. 39) of the experimental and control groups appear to be in complementary distribution. The experimental group shows a large increase in

FIGURE 38

MULTI-WORD UTTERANCES

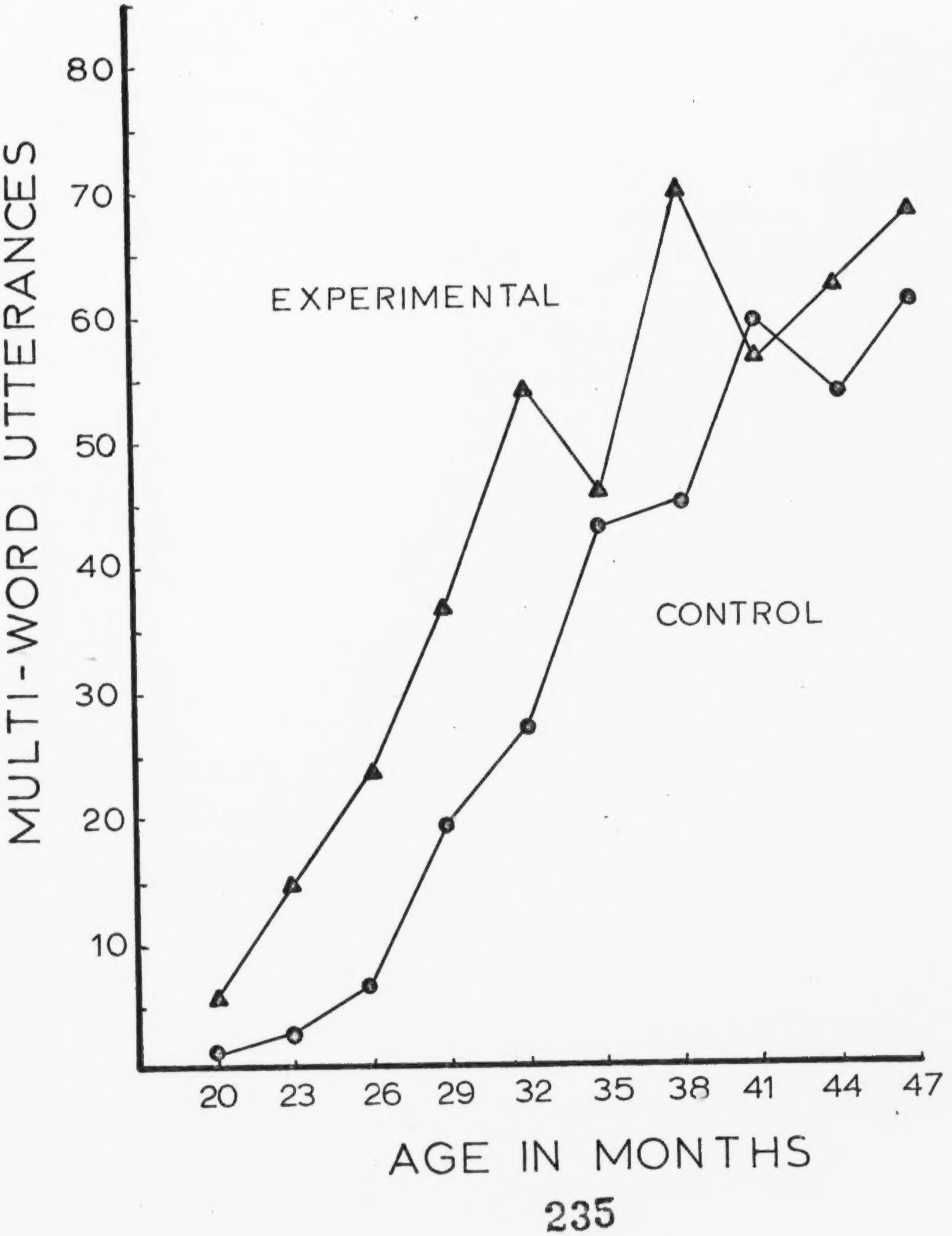


FIGURE 39

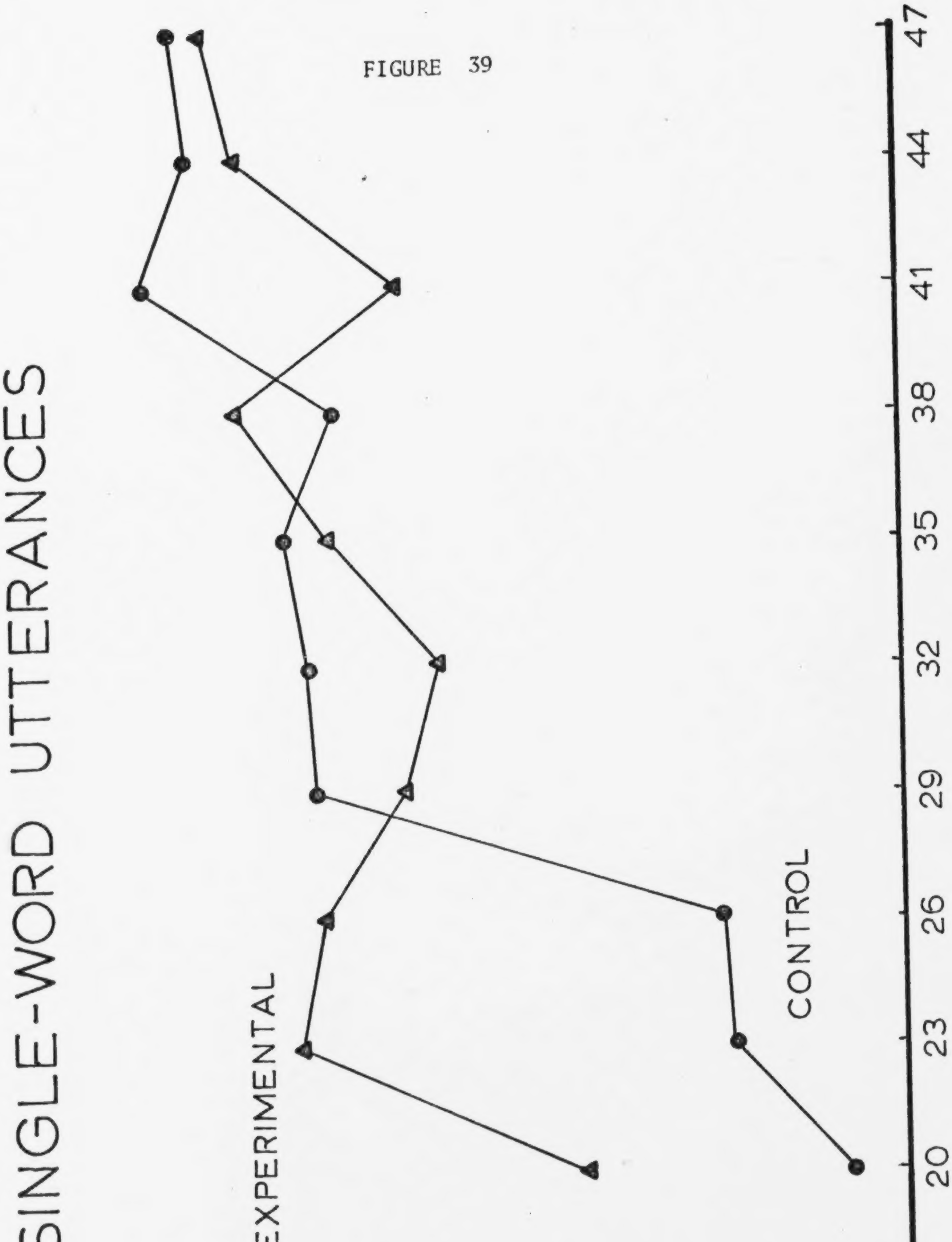

SINGLE-WORD UTTERANCES
EXPERIMENTAL
CONTROL
SINGLE-WORD UTTERANCES
20
15
10
5
20
23
26
29
32
35
38
41
44
47
AGE IN MONTHS
236

TABLE 20

TOTAL SINGLE-WORD UTTERANCES

	Age in Months									
	20	23	26	29	32	35	38	41	44	47
Experimentals	8.4	15.9	15.3	13.1	12.1	15.0	17.4	13.2	17.3	18.3
Controls	1.4	4.4	4.7	15.3	15.6	16.2	14.0	19.8	18.6	19.0

single-word utterances from 8.4 at 20 months to 15.9 single word utterances at 23 months. The mean number of single-word utterances varies over the next 24 months from a high of 18.3 at 47 months to a low of 12.1 at 32 months. The control group also fluctuates after an increase in single-word utterances from 4.7 at 26 months to 15.3 at 29 months. Apex for the control group is 19.8 at 41 months, the nadir after 26 months is 12.1 at 32 months.

The data for spontaneous utterances (Fig. 40) appears to be closely related to the data for total utterances. The experimental group gradually increases from 10.8 spontaneous utterances at 20 months, to 61.9 at 32 months. After a small drop to 58.0 at 35 months, the curve again climbs to 85.4 at 38 months, decreases to 68.1 at 41 months, and slowly increases to 85.9 at 47 months. The control group increases from 1.6 spontaneous utterances at 20 months, to 57.0 at 35 months. At 38 months, the curve decreases slightly to 56.7, then climbs to 77.9 at 41 months, decreases to 71.2 at 44 months, and finally increases to 78.8 at 47 months.

TABLE 21

SPONTANEOUS UTTERANCES

	Age in Months									
	20	23	26	29	32	35	38	41	44	47
Experimentals	10.8	24.1	32.3	44.4	61.9	58.0	85.4	68.1	78.5	85.9
Controls	1.6	5.3	6.5	32.5	39.8	57.0	56.7	77.9	71.2	78.8

The experimental groups curve for total repetitive utterances (Fig. 41) shows an increase from 3.1 at 20 months, to 6.3 repetitive utterances at 23 months. The next 24 months shows a decrease from 6.1 at 26 months to 0.7 at 47 months. The control group increases from 0.5 total repetitive utterances at 20 months to 1.9 repetitive utterances at 23 months. The curve then drops to 1.8 at 26 months, increases to 3.3 at 32 months, decreases to 2.0 at 35 months, increases to 2.1 at 38 months, and finally decreases to 1.0 repetitive utterances at 47 months.

FIGURE 40

SPONTANEOUS UTTERANCES

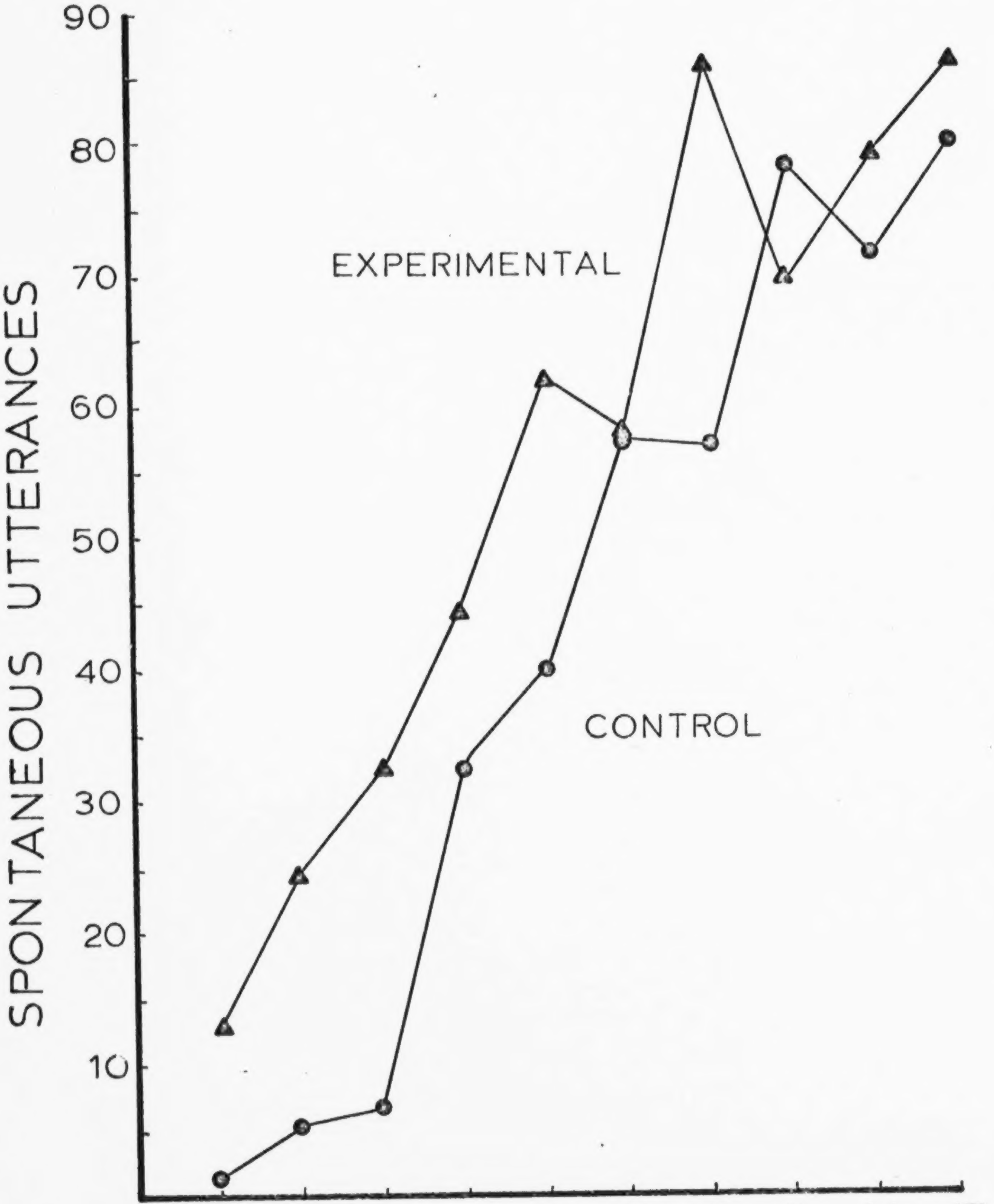


FIGURE 41

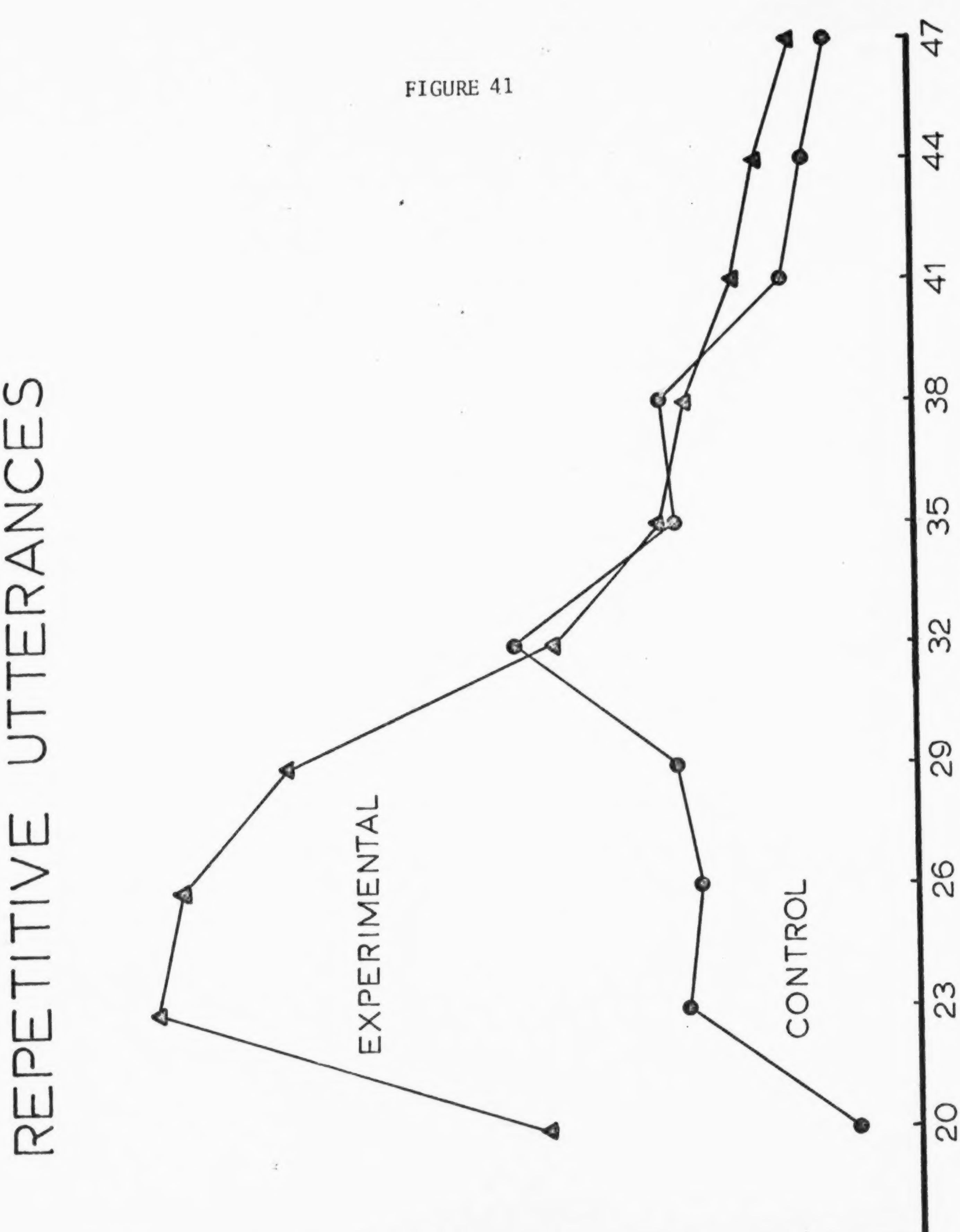

REPETITIVE UTTERANCES
REPETITIVE UTTERANCES
7
6
5
4
3
2
1
EXPERIMENTAL
CONTROL
20
23
26
29
32
35
38
41
44
47
AGE IN MONTHS

TABLE 22

REPETITIVE UTTERANCES

	Age in Months									
	20	23	26	29	32	35	38	41	44	47
Experimentals	3.1	6.3	6.1	5.2	3.0	2.1	1.9	1.5	1.3	0.7
Controls	0.5	1.9	1.8	2.0	3.3	2.0	2.1	1.1	0.9	1.0

The data collected and evaluated for total vocabulary range, gross number of morphemes, and mean length of utterance indicates a fairly consistent quantitative difference in frequency counts between the experimental and control groups. Total vocabulary range (Fig. 42) for the experimental group shows a consistent developmental increase in mean number of unique vocabulary responses from 8.0 items at 20 months to 35.8 responses at 35 months. At 38 months the mean number of vocabulary items increases sharply to 77.8, then decreases slightly to 72.0 at 41 months, and then accelerates to 90.1 responses at 47 months. The control group has a parallel developmental acquisition of vocabulary items only the absolute counts are considerably less. The control group's curve climbs from 1.5 vocabulary item responses at 20 months to 31.5 responses at 35 months. The curve jumps rapidly to 62.1 responses at 38 months, asymptotes for six months and then climbs to 71.9 responses at the 47 month period.

TABLE 23

TOTAL VOCABULARY RANGE

	Age in Months									
	20	23	26	29	32	35	38	41	44	47
Experimentals	8.0	15.3	29.4	27.4	33.4	35.8	77.8	72.0	83.8	90.1
Controls	1.5	4.7	5.2	18.5	17.5	31.5	62.1	63.0	63.7	71.9

Gross number of morphemes (Fig. 43) for the experimental group increases from 26.2 morphemes at 20 months to 209.1 at 32 months. After a slight decrease over the next three months, the gross number of morphemes

TABLE 24

GROSS NUMBER OF MORPHEMES

	Age in Months									
	20	23	26	29	32	35	38	41	44	47
Experimentals	26.2	58.5	91.2	152.2	209.1	205.3	287.3	273.4	340.6	353.3
Controls	2.8	12.3	16.7	75.6	[illegible]	176.4	150.2	272.1	239.5	299.5

FIGURE 42

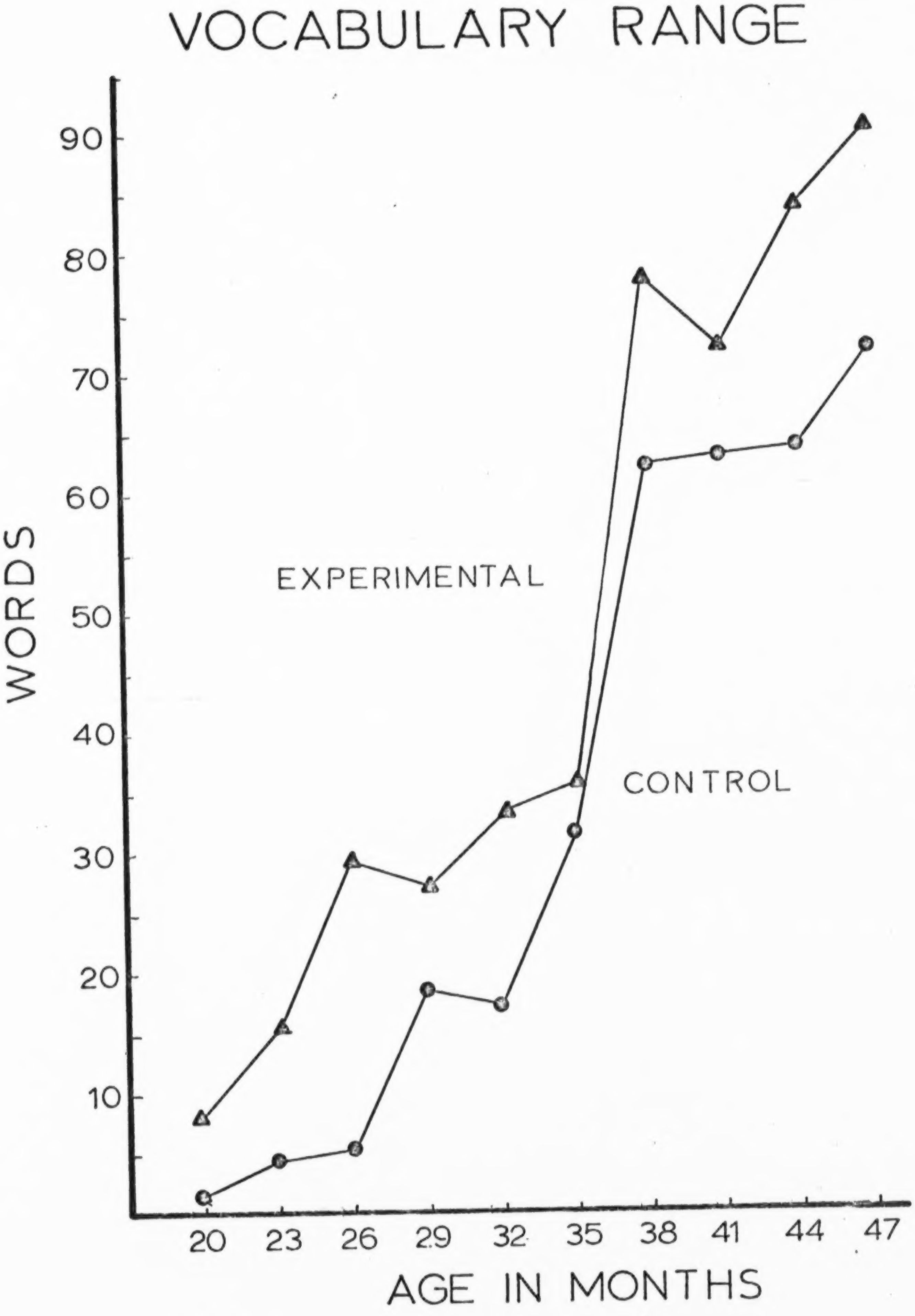
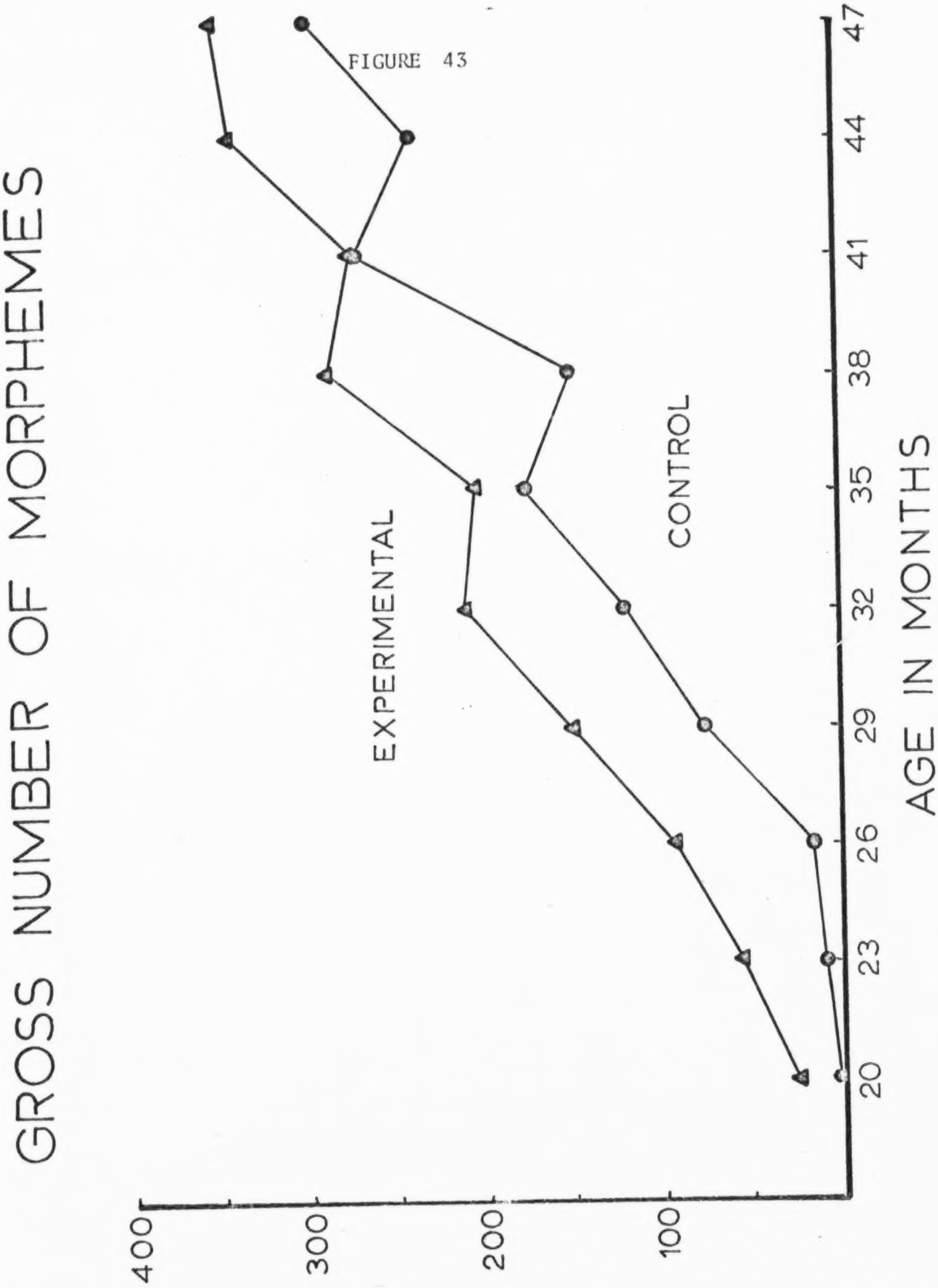

VOCABULARY RANGE
WORDS
90
80
70
60
50
40
30
20
10
EXPERIMENTAL
CONTROL
20
23
26
29
32
35
38
41
44
47
AGE IN MONTHS

FIGURE 43


GROSS NUMBER OF MORPHEMES
MORPHEMES
400
300
200
100
EXPERIMENTAL
CONTROL
20
23
26
29
32
35
38
41
44
47
AGE IN MONTHS

increased to 287.3, then decreased again to 273.4 at the 41 month period and gradually increased to 353.3 at 47 months. The control group increased its average number of morphemes from 2.8 at 20 months, to 176.4 at 35 months in relatively small sequential steps. At 38 months the number of unique vocabulary items decreased to 150.2. At 41 months, the number of 273.1 followed by 239.5 morphemes at 44 months and 299.5 at 47 months.

Mean number of morphemes in an utterance (Fig. 44) showed comparatively congruent development in both groups over time. The experimental group showed an increase in utterance length from 1.3 morphemes per utterance at 20 months, to 3.4 morphemes per utterance at 32 months. The length of an utterance remained very stable for six months until it increased to 3.7 morphemes at 41 months, to 4.1 morphemes at 44 months and stabilized at 4.0 at the 47 month period. The control group averaged 0.2 morphemes per utterance at the 20 month level. The next 12 months showed an increase to 2.9 morphemes per utterance at the 32 month level. The length of an utterance apparently stabilizes around 3.0 morphemes for the subsequent 15 months, with 3.3 morphemes per utterance being the average length of utterance at the 47 month period.

TABLE 25

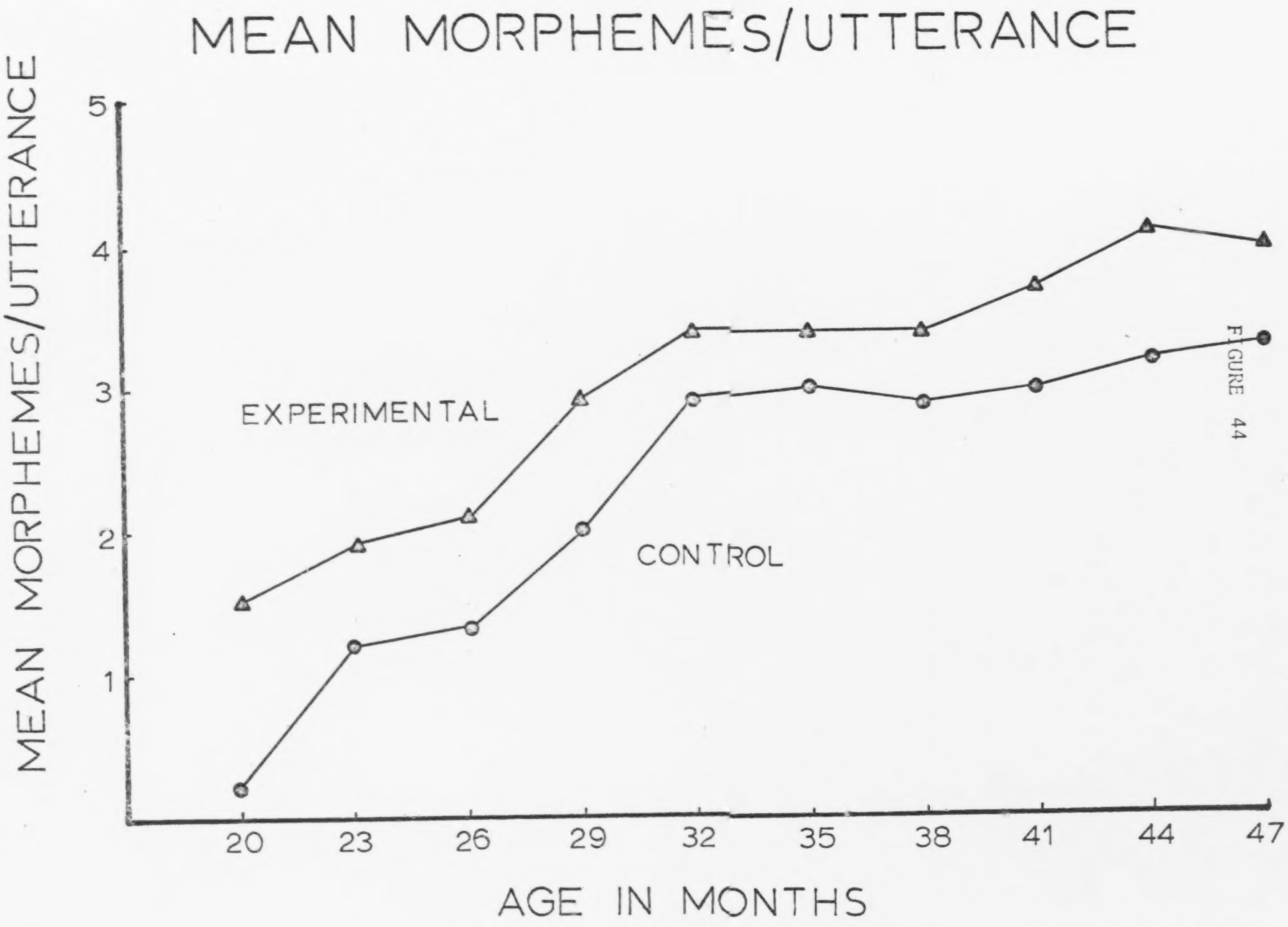
AVERAGE NUMBER OF MORPHEMES IN AN UTTERANCE

	Age in Months									
	20	23	26	29	32	35	38	41	44	47
Experimentals	1.3	1.9	2.1	2.9	3.4	3.4	3.4	3.7	4.1	4.0
Controls	0.2	1.2	1.3	2.0	2.0	3.0	2.9	3.0	3.2	3.3

Discussion and Conclusions

The data from free speech language analysis seems to be most sensitive to inter-group differences at the earlier month periods. The free-speech analysis demonstrates initial language growth of the experimental group far superior to the control. The eight quantitative measures yield some interesting developmental trends. The first eight months of growth seems to be a critical period of development for the experimental group, or conversely, a retarded period of growth for the control group. Even though a number of morphemes is obviously highly interrelated with total utterances, the fact that the experimental children are producing a significantly larger number of unique vocabulary items, and are also using utterances that are almost 50 percent longer than the control, gives added meaning to the measure of gross numbers of morphemes. Indeed, this holds serious implications for the development of both linguistic and perceptual skills. An early start at perceptual discrimination and labelling is, it appears, crucial for subsequent development of language skills.

FIGURE 44


MEAN MORPHEMES/UTTERANCE
MEAN MORPHEMES/UTTERANCE
5
4
3
2
1
EXPERIMENTAL
CONTROL
20
23
26
29
32
35
38
41
44
47
AGE IN MONTHS

Vocabulary range is a factor that points to qualitative differences between groups. The range of vocabulary at the 47 month period for the experimental group is 20 percent greater than the controls. At the 47 month period the experimentals have more unique vocabulary items than they do total utterances. The range for controls is never as great as their number of total utterances. Furthermore, at all ages the experimentals use a greater number of unique words per utterance than the controls. This apparent growth in vocabulary for both groups at the 38 month period is due to a changing in sampling technique.*

Experimental single-word utterances increase sharply from 20 to 23 months and are then relatively stable with a mild rise at 38 months. Control single-word utterances are very low from 20 to 26 months and then show an enormous increase at 29 months and continue to increase thereafter. This points to the qualitative differences in speech between the control and experimental group's language sample. The amount of single-word utterances is a key factor in determining sentence length and complexity of grammar. The quantitative increase in single-word utterances by the control group is suggestive of a retarded development of sentence length and complexity of grammar. On the other hand, the quantitative stability in the experimental group, we have interpreted *to indicate qualitative growth.*

Spontaneous multi-word utterances follow the trends of total utterances, except that the gaps separating the performance of experimental children from the control children are larger in the early months and smaller in the later months. This is due to the function of spontaneous single-word utterances.

Repetitive utterances never make up the majority of total utterances. In the early months they constitute approximately 25 percent of the total and then drop off as the total number climbs. The experimentals show a peak at 23 and 26 months, which is never duplicated by the controls; and overall, they have more than twice as many repetitive utterances as the controls. We have accepted repetition as an index of the first process of language learning mentioned by Brown and Bellugi (1964), the process of imitation by the child of the adult utterances in the environment. The fact that the experimental group reaches a peak in the number of repetitive utterances at a very early age, plus the fact that overall the experimental group has twice as many repetitive utterances as the control group suggests that the experimental group more thoroughly accomplishes what may well be the primary or first process of language acquisition.

Mean length of utterance could be the clearest index of developmental differences in language performance between groups. While the measure of total utterances solely reflects gross quantities of verbal outputs, the use of number of morphemes per utterance as a measure more clearly reflects sentence complexity. It seems quite reasonable to assume that increases in number of sentence components is an expression of a greater verbal and linguistic sophistication. As a child grows he acquires more and more nominal categories for classifying perceptual events. Eventually, he uses these categories to construct meaningful communications. Our data indicates that the number of components in an utterance for the experimental group is 25 percent greater than for the control group.

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*Previous to 38 months, the language samples are approximately 45 minutes, at this and succeeding age levels the sample is 15 minutes; thus skewing the vocabulary count.

As our results indicate, free speech language analysis appears to be an effective method of delineating both quantitative and qualitative differences between the control and the experimental groups. Quantitative differences at the early months favor the experimental group. The qualitative differences suggested by four factors in the quantitative data, viz., 1) the number of repetitive utterances, 2) the number of single-word utterances, 3) vocabulary range and 4) the mean number of morphemes per utterance are replicated by highly structured language measures (e.g., sentence repetition and the ITPA) that also seek to establish developmental language patterns. The fact that there is a great deal of congruence between these tests and the free-speech data provides a more comprehensive picture of the process of language acquisition and development. It is true that the sensitivity of free speech measures decreases at later month periods. This may be due to the increase in the 'semantic load' factor for any utterance in the speech of both groups of children. If a scale were devised to measure the 'semantic load' of a child's speech -- a scale that would quantify the amount of communication contained in an utterance -- perhaps free speech data would reflect the differences between experimental and control groups that more structured tests indicate occur at later month periods. Thus far, free speech sampling techniques are most sensitive to early language growth performance when language behavior is far more quantitative than qualitative. It is in this early period that language tends to be used to react to situations and to make a comment all with a demonstrative or identifying remark. Later, language tends to act upon the environment in attempts to initiate or actively appreciate the situation. These attempts introduce the abstract and more complex syntactic aspect of thought and language. This thesis is consistent with the treatment of thought and language by both Vygotsky and Piaget.

Measuring Language Comprehension by Means of a Grammatical Comprehension Test

Featuring production in language acquisition research has been previously criticized. For example, the early "writing - grammars" approach of Brown (Brown, Fraser & Bellugi, 1963) was criticized by Noam Chomsky (1964) at the Dedham conference on language acquisition for its sole reliance on production data. Much of what is known about language acquisition is based on children's production of speech, and yet it is eminently reasonable that many of the inferences drawn about children's language competence would be different if based on comprehension (McNeill, 1966). Furthermore, the length and grammatical maturity of the child's linguistic productions in language sampling sessions have proven to be highly sensitive to all manner of stimulus and situational variables, suggesting that the production indices presumed to reflect underlying linguistic competence are extremely sensitive to diagnostic error (Flavell & Hill, 1969; Cazden, 1970). Although the study of comprehension involves formidable difficulties and would demand some ingenuity on the part of the researcher, it must be concluded that improved measures and studies of speech comprehension are very much needed at this point (Ervin-Tripp & Slobin, 1966).

Two tests which measure the child's comprehension of a range of syntactic categories are the Test of English Morphology (Berko, 1958) and the Illinois Test of Psycholinguistic Abilities (Kirk & McCarthy, 1966). There are, however, several limitations in the use of either of these tests. On the one hand, the Berko Test measures just the morphological component of syntax while the ITPA measures a whole range of interrelated linguistic abilities making it extremely difficult to isolate the grammatical element. Second, both these tests measure a child's syntactic maturity through his production rather than his comprehension abilities and thus suffer from the deficiencies mentioned above. Thirdly, both of these tests were designed for children of four years and older and were not thought to be adabtable to children as much as a year younger. Therefore, a different test was needed for our purposes.

The Bellugi-Klima tests of Grammatical Comprehension were chosen to investigate what children understand of the syntax of English. The test is designed to make use of simple physical responses to verbal requests as a means of determining comprehension of syntax reliably. The administration of the test is in a carefully controlled situation such that any extraneous cues from the situation itself are minimized. The test items were constructed so that the only way the child can give a correct answer is by comprehension of the particular construction to be tested. The test items are also designed so that the words used are part of the child's vocabulary. The words are known to most children of this age (3-4 years) and unfamiliar words are taught to the child before the actual testing sequence begins.

The purpose of the grammatical comprehension test* is two twofold: 1) to assess the differential development of grammatical comprehension between a group of children who have been participating in an early education program and a similar group of children who have not; 2) to develop data derived longitudinally on the developmental course of the acquisition of various syntactic features.

Method

Subjects: The subjects consisted of all the children over the age of 36 months involved in the Family Rehabilitation Project. This project is directed by the Research and Training Center of the University of Wisconsin.

The children of this project were selected from a population of new offspring, born to low socioeconomic status mothers whose tested IQ's were 80 or below. Part of this population of children was assigned to participate in an educational stimulation program and have been referred to as the Experimental group (E). The other children, selected from the same or original population of offspring, were considered to be a Control group (C). These latter children do not participate in the daily stimulation program and are only tested periodically. Each child was tested at the age of 36 months and every third month thereafter. All the Ss are low SES inner-city Black children.

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*This test was a modified version of the Bellugi-Klima test of grammatical comprehension. The modification was implemented by Dr. R. Dever.

Instrument and Procedure: The technique of the test is exemplified by the subtest (Active & Passive Voice Comprehension) presented in Table 26.

TABLE 26

SAMPLE SECTION FROM THE GRAMMATICAL COMPREHENSION TEST:

COMPREHENSION OF ACTIVE VS. PASSIVE VOICE

Materials	Arrangement	Instructions
Boy and Girl Dolls; Toy pig and cow	Boy and Girl on table, face up	Here is a boy (hold up and replace) and here is a girl (hold up and replace). Here is how we push (hold boy and girl together and push back and forth). 1. Show me: The boy pushes the girl. 2. Show me: The boy is pushed by the girl.
	Pig and cow lying on the table	Here is a pig (hold up) and here is a cow (hold up). See, they can chase each other (demonstrate). 3. Show me: The pig chases the cow. 4. Show me: The pig is chased by the cow.

The language examiner, a middle-aged black woman, scores the test as she gives it. A response is either correct or incorrect. If no response is given by the child, the item is scored as incorrect. There are sixteen subtests with a total of sixty-one questions. The entire test can be administered within 25 minutes.

For the moment, consider the passive construction as an example of a syntactic item to be tested. For a valid test of this construction, the following must be considered: 1) Situational cues must be eliminated. Take the sentence: The apple was eaten by the doll. It is a well-formed passive sentence. The child could be asked to act it out and would be provided with an apple and a doll. However, should he perform correctly, it would not be conclusive evidence that he understood the passive construction. He might do exactly the same thing if given the apple and the doll and told, "Do something with these." In his world, children are most likely to eat apples, and not sit on them or put them on their heads or smash them or be acted upon in any way by apples. This, then, would not be a good test as it stands. 2) The child must know the vocabulary to test his understanding of syntactic constructions. If the child were to be asked to act out: "The construction was demolished by the superintendent," a failure to perform correctly would not indicate whether he failed to understand the words or the passive construction. In each case the objects must be known by the child to test understanding of syntax only. 3) The understanding of syntax must be requisite for the set up so that they differ minimally with respect to the syntactic problem under study. Correct responses require differentiating the two. With passive sentences, sentences are used in which either the first or second noun can be the subject or object of the verb. The verb push can take an animate subject and an animate object: a boy can push a girl and vice versa. This furnishes the basis for a minimally contrasting pair of sentences, where the only difference between the two sentences is in word order, that is, in subject-object relations. "The boy is pushed by the girl," and "The girl is pushed by the boy." This, then, is the test for understanding of the passive construction in English.

A number of significant syntactic constructions are tested for in this way. These tests examine comprehension by requiring the children to process the sentence in language-like situations, and to act out their understanding of the relationship of parts of a sentence. The Bellugi-Klima test of grammatical comprehension contains sixty-one (61) questions in sixteen (16) subtests. The items of syntax measured by the sixteen subtests are: 1) Active vs. Passive Voice; 2) Prepositions; 3) Singular vs. Plural Nouns; 4) Possessives; 5) Negative vs. Affirmative Auxiliary Verbs; 6) Singular vs. Plural Nouns & Verbs; 7) Conjunctions (And/Or); 8) Conjunctions (Either/Neither); 9) Conjunctions and Comparatives; 10) Adjectival Modifiers; 11) Negative Affixes; 12) Reflexive Pronouns; 13) Reflexive vs. Reciprocal Pronouns; 14) Passives: Non-Reversible; 15) Comparatives; 16) Self-Imbedded Sentences.

Results

Mean raw scores (number of items correct) for both the Experimental and Control groups were calculated for each age level (Table 27, Fig. 45). The scores are considerably higher for the Experimental group than for the Control group. At the first age level (36-38 months) the average Experimental total score is 32.9 which represents correct answers for 54% of the test. The average Control score for the same period is 20.8 representing 34% correct responses. At the last age level (54-56 months) a year and a half later, the score for the Experimental group is 47.7 representing 78% correct and for the Control group 30.3 representing 50% correct responses. The Experimental group, it should be noticed, increases its score at every age level whereas the Control group increases its score at the first four age levels and then remains relatively stable.

Another method of scoring is that of the percentages of individual subtests responded to correctly by a group. A subtest is correct only when every item in it is correct. The results for this method of scoring are shown in Table 28, Fig. 46.

TABLE 27

NUMBER OF SUBJECTS

Age in months	36	39	42	45	48	51	54
Experimentals	17	14	20	17	17	11	11
Controls	12	15	17	15	12	8	7

ITEMS CORRECT ON GRAMMATICAL COMPREHENSION TEST

Age in months	36	39	42	45	48	51	54
Mean E score	32.9	38.0	40.1	41.7	43.7	46.5	47.7
Mean C score	20.8	25.2	27.8	30.3	30.2	33.4	30.3

TABLE 28

MEAN PERCENTAGE OF SUBTESTS CORRECT

Age in months	36	39	42	45	48	51	54
Experimentals	23%	31%	39%	40%	45%	54%	60%
Controls	9%	11%	14%	15%	16%	22%	18%

The trends are similar to those of the raw scores. The experimental

Figure 45

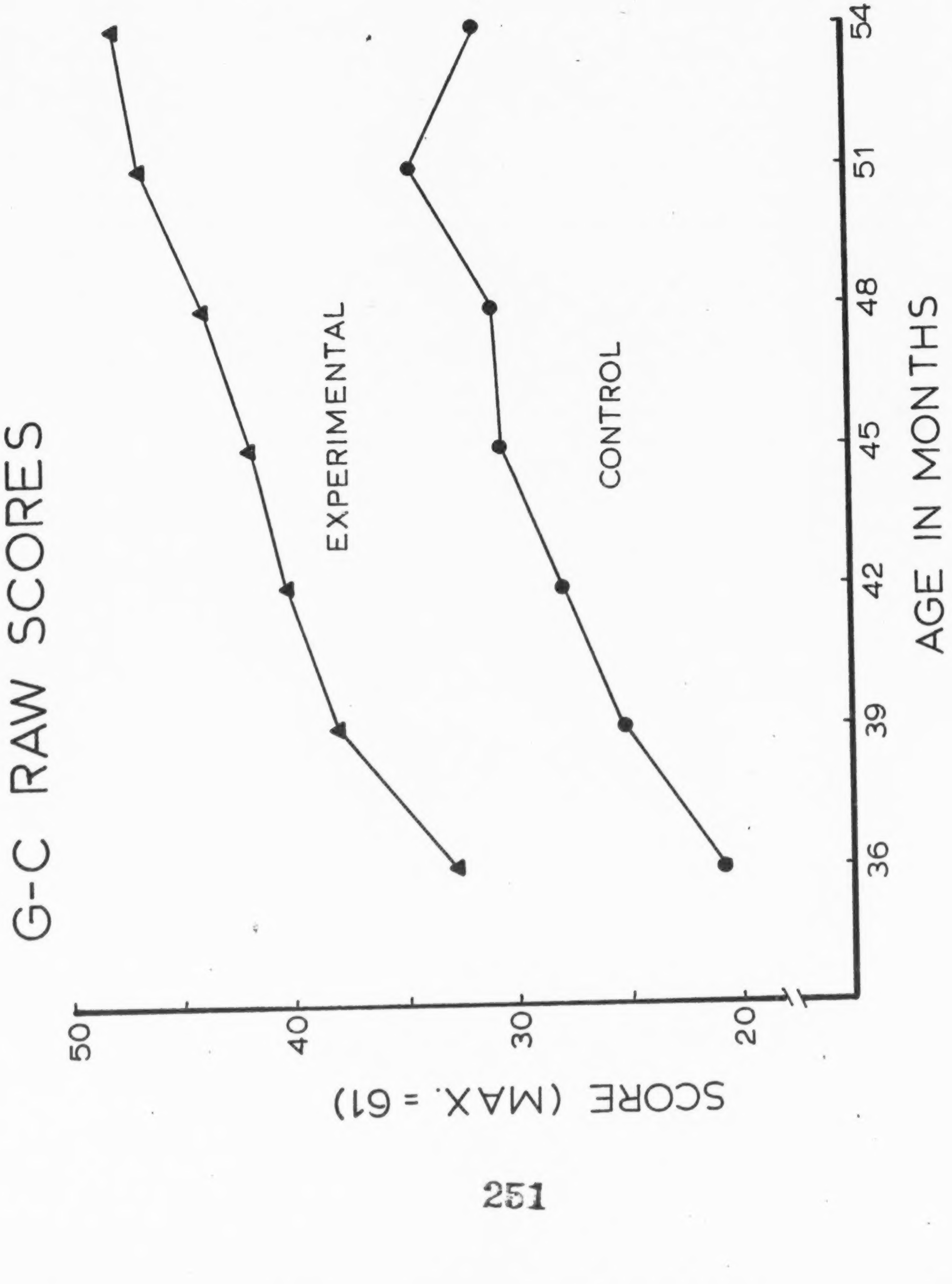
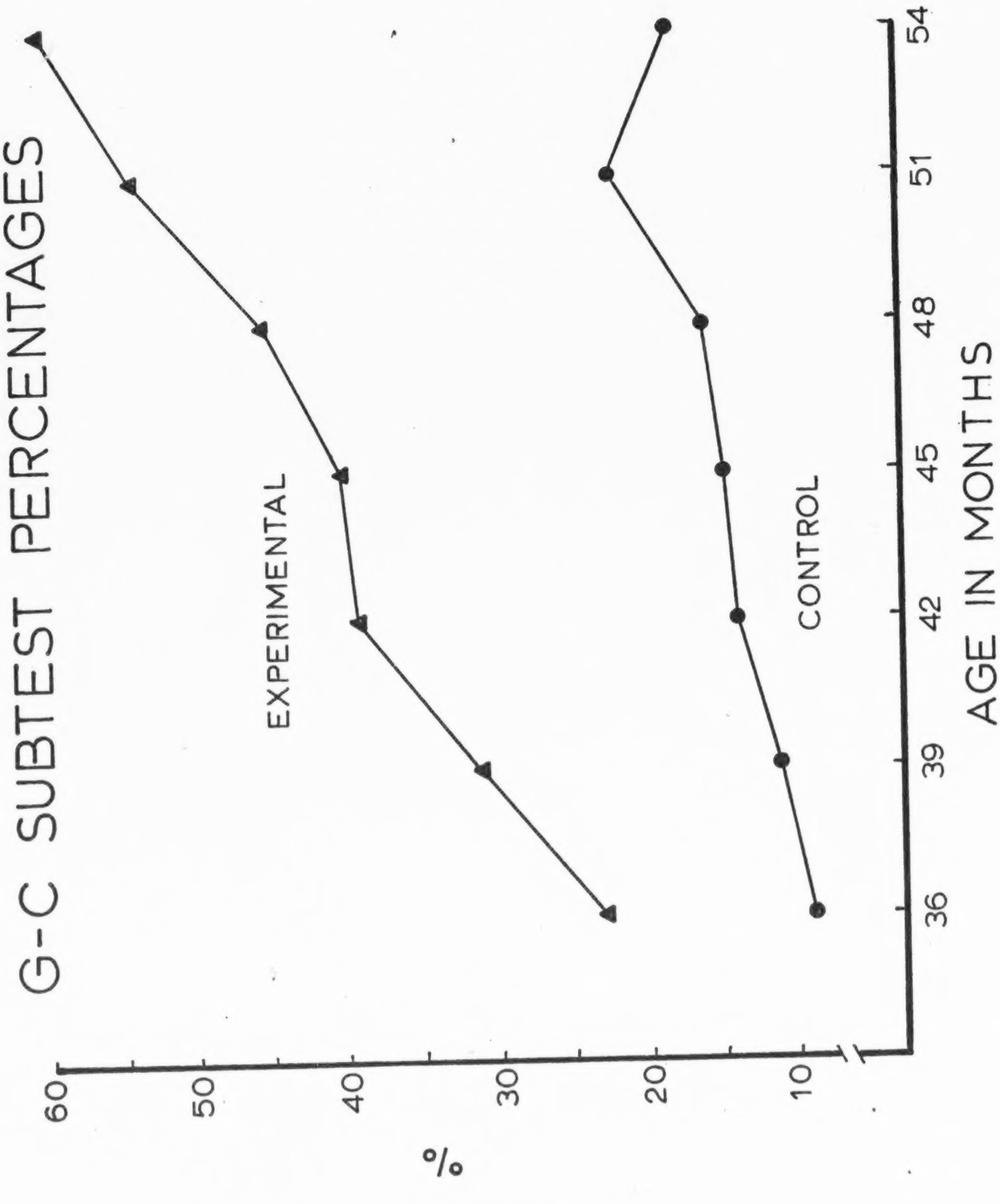

G-C RAW SCORES
EXPERIMENTAL
CONTROL
SCORE (MAX. = 61)
50
40
30
20
36
39
42
45
48
51
54
AGE IN MONTHS

Figure 46


G-C SUBTEST PERCENTAGES
EXPERIMENTAL
CONTROL
%
60
50
40
30
20
10
36
39
42
45
48
51
54
AGE IN MONTHS

scores increase at every age level from 23% to 60%. The control scores also increase but more moderately from 9% to 22%.

Discussion

The results clearly show that the Experimental children's comprehension covers a much wider range of syntactic categories than does that of the Control children. This is demonstrated by the Experimentals having successfully accomplished more items. This indicated that they had acquired a better grasp of grammatical comprehension thus far than had the Controls. Additional support for this superior performance becomes obvious from a perusal of the results, which shows the Experimentals to have a much higher percentage of correct subtests.

The problem of dialect must be considered, particularly in relation to the superior performance of the E group, which has participated in a special preschool intervention program. All of the children come from primarily Negro neighborhoods in the inner-city of Milwaukee. In such areas there is a cultural influence on language which produces a dialect spoken by most of the members of the cultural group. Typically, black dialect within an area is essentially uniform and differs markedly from Standard English (Entwisle, 1968; Loban, 1963; and Stewart, 1965). Indeed, if a child has acquired the majority of the syntactic patterns of a non-Standard dialect then he would be expected to have some difficulty in scoring well on the GC test, precisely because the grammatical comprehension test measures the patterns acquired in the Standard dialect. There is, of course, no test for a non-Standard dialect; there isn't even a complete description of the Northern urban Black dialect. Therefore, it is difficult, to say the least, to evaluate the effects of Black dialect on the results. Both the Experimental and the Control children speak Black dialect and both have been exposed to Standard dialect through radio and television programs. What is most true, however, is that the Experimental children are further acquainted with Standard dialect spoken by some of their teachers. This closer acquaintance with Standard dialect is of a special nature since it may have made the Experimental children more sensitive to standard syntactic patterns, enabling them to be more successful on some of the Grammatical Comprehension Subtests. It is special in its nature because it required active communication from the children compared to the passive exposure associated with radio and tv. It may not be so much the controls' lack of acquaintance with Standard dialect but their lack of experience in active communication -- a factor which is not to be taken lightly. Early experience of this sort in language behavior portends profound implications for the development of the higher mental processes of thought. Moreover, if one takes a closer look at the results, the possible effects of dialect is somewhat minimized. The results of two subtests are particularly enlightening. Subtest 3 tests singular vs. plural nouns (jack-jacks, ball-balls). These are Standard dialect forms; Black dialect doesn't distinguish these forms morphologically. Dialectal interference would seem to predict poor results on this subtest but subtest 3 is actually performed well by both groups (Controls' Subtests Correct: 55% Early, 75% Late; Experimentals' Subtests Correct: 79%

Early; 87% Late). Subtest 4, on the other hand, tests prepositions (in, on, and under) which are the same in both Standard and Black dialect. Nevertheless, the results show differences between the groups (Controls' Subtests Correct: 40% Early; 45% Late; Experimentals' Subtests Correct: 100% Early; 96% Late). The Controls' poor performance on the Grammatical Comprehension Test, then, is not due to dialectal interference but to a generally poorer grammatical comprehension. On the other hand, the more successful performance of the Experimental children on this test shows that they have the ability necessary to process grammatically complex commands.

The Use of a Sentence Repetition Test to Measure Language Imitation

A child's ability to repeat certain grammatical structures may be an indication of his understanding of these structures as well. The statement made by Fraser, Bellugi, and Brown in 1963 that linguistic imitation is "a perceptual-motor skill not dependent on comprehension," although endorsed by Lovell and Dixon in 1967, has not been supported by other investigators. For example, neither Osser, Wang, and Zaid (1969) nor Nurss and Day (1971) found significant differences between children's performances on imitation and comprehension tests. Moreover, both studies found, among the black children given the imitation tests, a significant number of responses recoded into a nonstandard dialect, giving support to the suggestion that children may not be able to repeat structures that they nevertheless understand. This phenomenon is perhaps evidenced by their recoding of the structures into the patterns they habitually use. This same point had previously been made by Slobin (1967), who furthermore observed that, given the proper contextual support, a child can spontaneously produce a fairly complex utterance which he may be unable to repeat later in the absence of such support, even when the same sentence is presented to him as a model for imitation. If there is a closer connection between what a child can imitate and what he can understand and produce than Fraser _et al_. (1963) have been able to find, it would support Slobin's conclusion that sentence recognition and imitation are filtered through the individual's productive linguistic system, as well as his suggestion that the results of systematic probes of imitation "must be taken as a _conservative_ estimate of the child's linguistic competence."

While the present study is not primarily concerned with determining the extent of the relationship between imitation, comprehension, and production, it intends to provide additional evidence regarding the effectiveness of the sentence repetition test as a tool for measuring linguistic development, viz, differential linguistic development. In this study, a wide sample of sentence types has been presented for repetition at three-month intervals to two groups of children. Our primary concern is the differential rate of linguistic progress between the three- and four-year-old children participating in a preschool education program and those who are not. There are two major differences between our study and previous ones involving imitation tasks. First, all of the subjects are disadvantaged black children from the same urban community who have presumably been exposed to the same nonstandard dialect of English. Secondly, the tests have been replicated over a 24-month period, allowing observations to be made on the subjects' differential performance as they continued to take the same test at different stages of their linguistic development.

Method

Subjects: The subjects consist of all the children over the age of 36 months (N = 25) involved in the Family Rehabilitation Project being directed by the Rehabilitation Research and Training Center in Mental Retardation of the University of Wisconsin.

The children of this project have been selected from a population of newborn infants whose mothers are of low socio-economic status and have tested IQ's of 80 or below. Part of this population of children were assigned to participate in a preschool educational intervention program and are referred to as the Experimental Group (E). The other children (N = 19), selected from the same original population of infants but not participants in the daily stimulation program, are referred to as the Control Group (C). Each child is tested at 36 months of age and every third month therafter. This report covers the 152 tests so far given and scored.

Instrument and Procedure: The stimulus sentences consist of 34 sentences representing 16 clause types (Gleason, 1965) and their transformations (this test was originally devised by P. Fries and modified by R. Dever, University of Wisconsin). The sentences vary in length from four to eight words and from five to 11 morphemes, and range in complexity from kernels to double-base transformations. The transformations most commonly represented are the negative, yes/no interrogative, wh-interrogative, passive, and do transformations.

The language examiner for all the tests is a middle-aged black woman. Each session is begun by putting the child at ease, mainly be playing with various toys in the examination room. After several minutes the examiner gives the child the directions for the test ("I want to see if you can say what I say. Can you say this? Say, 'Frank ran in the street.'"). Each sentence is repeated once if the child does not respond or if his response is inaudible.

The test takes from seven to 15 minutes to administer. Each session is recorded on tape and later transcribed and scored by graduate students trained in applied English linguistics.

Analysis of Data: Responses are classified according to the following scale:

I. NO REPETITION (silence, babbling, talking about something else)

II. IMPERFECT REPETITION

  A. Changes in word order

  B. Omissions

  C. Substitutions or additions

III. EXACT REPETITION

Each of the imperfect repetition categories is subdivided into major (clause, phrase, and lexical-item) and minor (function-word and marker) levels. Transformations and other recodings, whether grammatical or not, are included under the category of substitutions or additions. Minor phonological distortions are not counted as deviations.

The scoring system described above accounts for the number of sentences containing any of the responses outlined. While responses in Categories I and III are counted only once, other responses may be counted twice or three times, according to the number of deviations from perfect repetition they exhibit. For example, a sentence containing both an omission and a substitution is counted under each of the two categories. Any deviation within a sentence is scored only once, regardless of the frequency of its occurrence; e.g., two separate occurrences of omissions within a sentence are recorded as one response containing omissions.

To provide a check on this method of scoring, another record has been kept on the number of morphemes omitted from each sentence, as well as the number actually repeated, and their percentages moted. Since it has been difficult to make quantitative measurements of substitutions and changes in word order, it is assumed that the percentage of morphemes not accounted for by omissions or repetitions would be attributed to these deviations. Response scores and morpheme counts have been noted for individual subjects as well as for the individual items on the test.

Results

Mean responses in each of the scoring categories for both groups at the five age levels tested are presented in Tables 29-33.In general, the Experimental Group demonstrated not only greater imitative skills than the Control Group at any age level, but also a more rapid and constand rate of improvement, as a comparison of the figures for the different age levels will show.

Although the figures in Table 29 (No Repetition) remain small throughout, they do indicate that while the children in the Experimental Group repeated every sentence presented to them after the age of 38 months, those in the Control Group continued not to repeat some sentences up to 47 months. The remaining differences between the two groups are unremarkable

TABLE 29

MEAN NUMBER OF RESPONSES IN CATEGORY I (NO REPETITION)

Age:	36 mos.	38 mos.	41 mos.	44 mos.	47 mos.
Group E:	0.82	0.26	0.00	0.00	0.00
Group C:	1.36	0.73	1.18	0.93	0.25

There does not seem to be any discernible trend in the number of responses involving changes in word order for either group (Table 30). While it may be noted that the Experimental Group responded with consistently fewer deviations in this category than the Control Group at any age level, the general performance of the two groups on this measure is comparable. It is interesting to note, moreover, that the children did confuse word order in some of their responses, contrary to Brown and Bellugi's (1964) assertion that such deviations do not occur in children's imitations of English sentences.

TABLE 30

MEAN NUMBER OF RESPONSES WITH CHANGES IN WORD ORDER

Age:	36 mos.	38 mos.	41 mos.	44 mos.	47 mos.
Group E:	1.53	1.53	0.94	0.69	0.86
Group C:	1.55	2.47	1.94	1.73	1.83

The two groups differed noticeably in the number of responses with both omissions (Table 31) and substitutions or additions (Table 32). Their comparative performance in these two categories is represented in Figure While both groups made consistently fewer omissions as they grew older, the difference between the two groups is apparent at any given age; in fact, at 47 months the Control subjects were still responding with slightly more omissions than the Experimental subjects did at 36 months. At the 47-month level, only 9.71 responses, or 29 per cent of all the sentences given, had omissions of any sort among the Experimental Group, whereas among the Control Group, 19.33 responses, or 57 per cent of all the sentences, contained omissions.

Both groups made fewer substitutions than omissions in their responses. As Figure 47 shows, however, the responses of the two groups exhibited strikingly different tendencies. Initially, the Experimental Group responded with more substitutions than the other gorup, but the number decreased with each succeeding age level. The Control Group, on the other hand, responded with increasingly more substitutions from 36 to 41 months, tapering off only slightly in the next two testing periods.

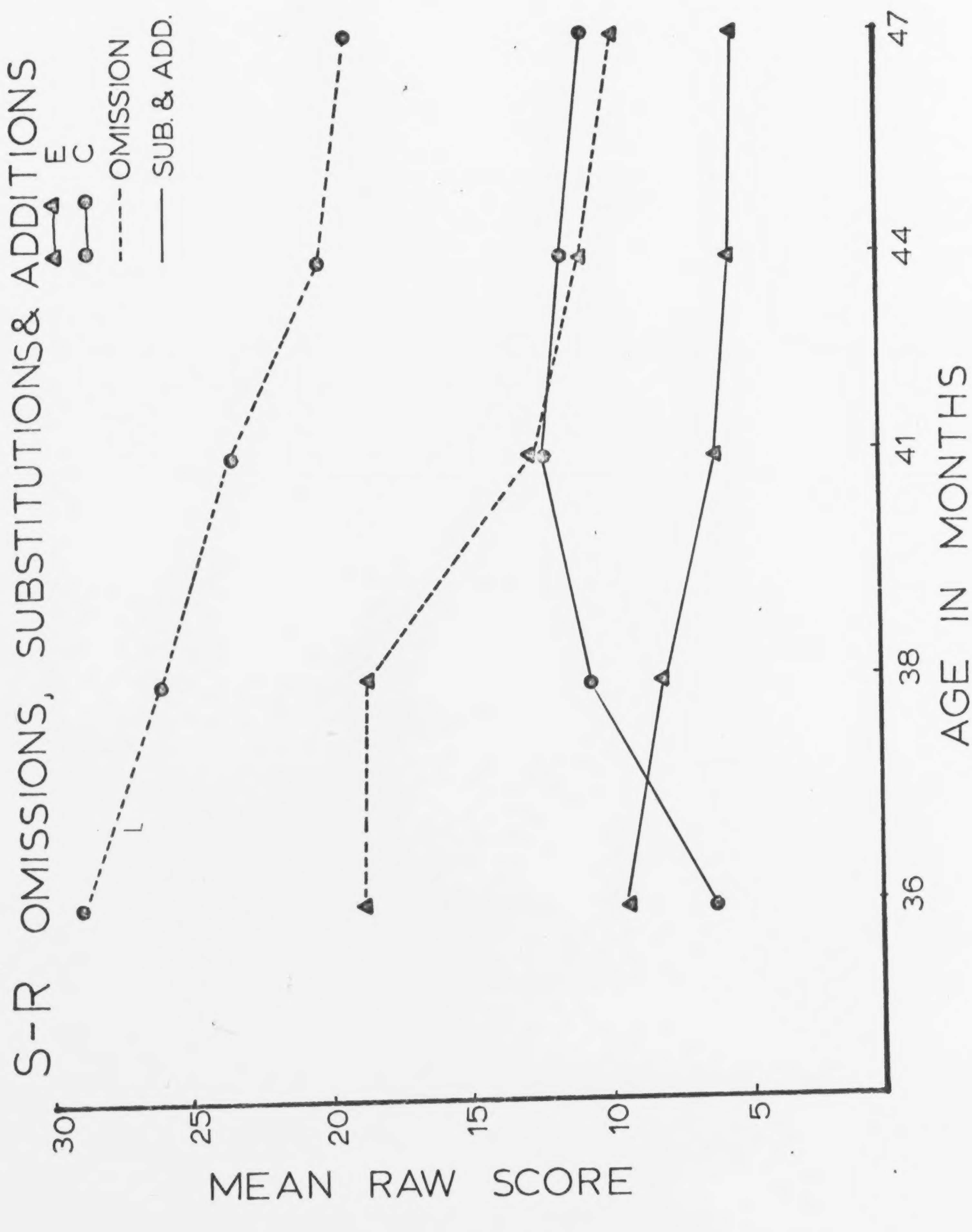

S-R OMISSIONS, SUBSTITUTIONS & ADDITIONS
E
C
OMISSION
SUB. & ADD.
30
25
20
15
10
5
MEAN RAW SCORE
36
38
41
44
47
AGE IN MONTHS

Figure 47

At 47 months they were making slightly fewer substitutions than they did at 41 months, but still more than the Experimental Group did at any age, and twice as many as the Experimental Group were making at the same age.

TABLE 31

MEAN NUMBER OF RESPONSES WITH OMISSIONS

Age:	36 mos.	38 mos.	41 mos.	44 mos.	47 mos.
Group E:	18.94	18.79	12.38	11.25	9.71
Group C:	28.91	26.13	23.47	20.33	19.33

TABLE 32

MEAN NUMBER OF RESPONSES WITH SUBSTITUTIONS OR ADDITIONS

Age:	36 mos.	38 mos.	41 mos.	44 mos.	47 mos.
Group E:	9.53	8.11	6.31	5.69	5.50
Group C:	6.37	10.80	12.35	11.47	10.92

Both groups increased the number of their exact repetitions as they grew older (Table 33). The Experimental Group, however, far outstripped the Control Group, responding with mope than twice as many exact repetitions at any age level and improving at a more rapid pace. Figure 48 illustrates this trend. At 47 months they were exactly repeating an average of 20.14 sentences, or 59 per cent of all the sentences on the test, while the Control children were exactly repeating an average of 9.5 sentences, or 25 per cent.

TABLE 33

MEAN NUMBER OF RESPONSES IN CATEGORY III (EXACT REPETITION)

Age:	36 mos.	38 mos.	41 mos.	44 mos.	47 mos.
Group E:	8.59	11.58	16.63	18.50	20.14
Group C:	3.82	5.33	5.94	7.33	9.25

In another analysis of the groups' differential performance, the mean number and percentage of morphemes omitted and repeated per sentence,

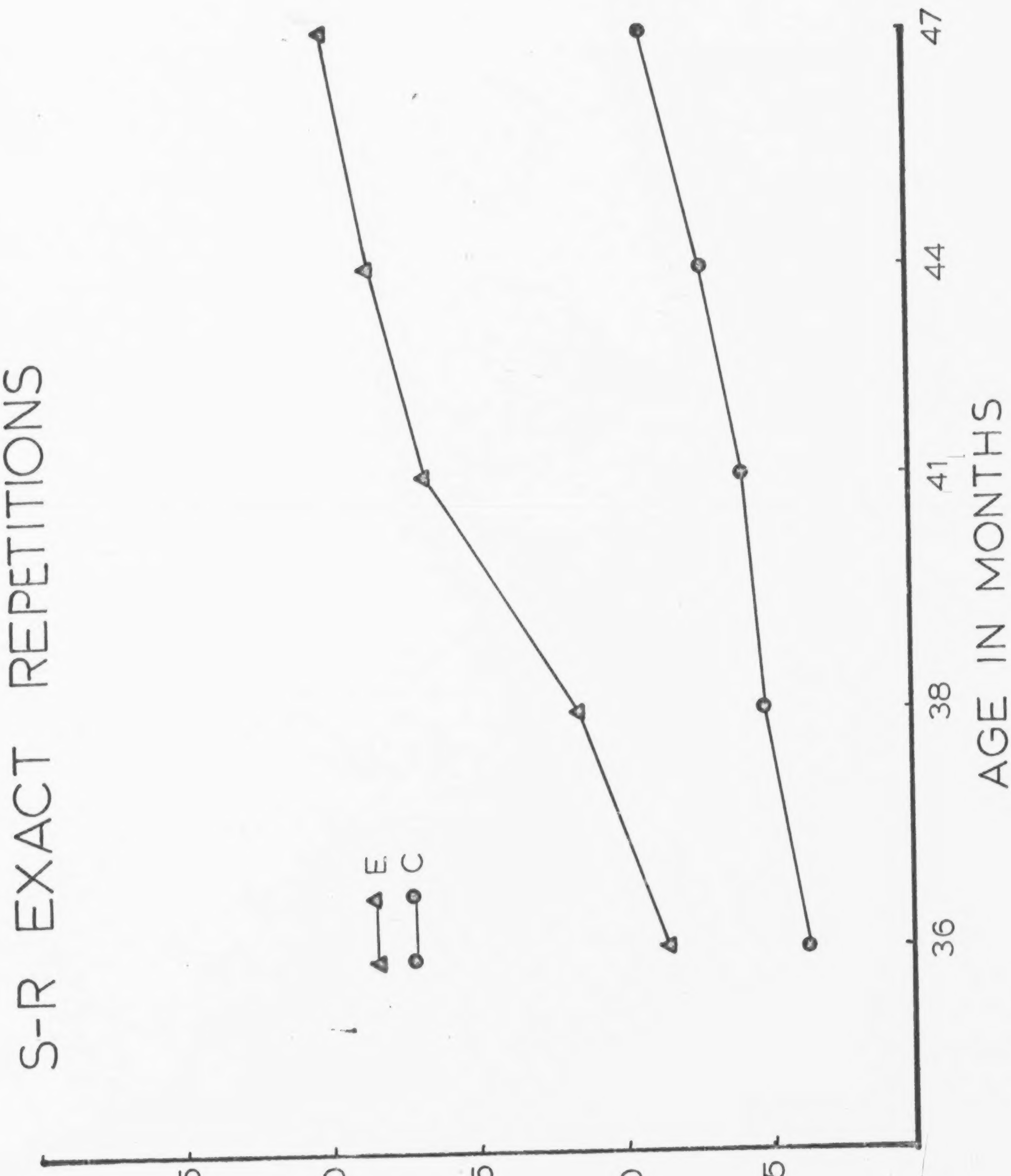

S-R EXACT REPETITIONS
MEAN RAW SCORE
30
25
20
15
10
5
AGE IN MONTHS
36
38
41
44
47
E
C

Figure 48

and the mean number of exact repetitions per sentence were calculated for each group at each age level. As they grew older, both groups tended to omit a smaller percentage of morphemes (Table 34) while tending to repeat a larger percentage (Table 35) of morphemes per sentence. Figure 49 illustrates these trends. The results of this analysis confirm those obtained through the scoring system discussed above: in both categories, the performance of the Experimental Group is consistently superior to that of the other group. For both morpheme omissions and morpheme repetitions, the figures for the Control Group at 44 and 47 months closely approximate those for the Experimental Group at 36 and 38 months, respectively, indicating a consistent difference of eight to nine months in the performance of the two groups. It would be interesting to see whether this difference will be maintained in later trials.

TABLE 34

MEAN NUMBER AND PERCENTAGE OF MORPHEMES OMITTED PER SENTENCE

Age:	36 mos.	38 mos.	41 mos.	44 mos.	47 mos.
Group E:	1.51	1.32	0.71	0.53	0.43
%:	19.5	17.1	9.2	6.9	5.6
Group C:	2.95	2.43	2.03	1.49	1.33
%:	38.2	31.4	26.3	19.3	17.2

TABLE 35

MEAN NUMBER AND PERCENTAGE OF MORPHEMES REPEATED PER SENTENCE

Age:	36 mos.	38 mos.	41 mos.	44 mos.	47 mos.
Group E:	5.51	5.80	6.67	6.95	7.06
%:	71.3	75.0	86.3	89.9	91.3
Group C:	4.29	4.67	4.88	5.39	5.87
%:	55.5	60.4	63.1	69.7	75.9

The percentage not accounted for by either morpheme omissions or morpheme repetitions may be attributed mainly to substitutions, since the figures for the other deviations are negligible. These remaining percentages are 9.2, 7.9, 4.5, 3.2, and 3.1 for the Experimental Group and 6.3, 8.2, 10.6, 11.0, and 6.9 for the Control Group at 36, 38, 41, 44, and 47 months, respectively. It will be noted that the trends for the two groups parallel those observed for substitutions in the earlier analysis of whole responses.

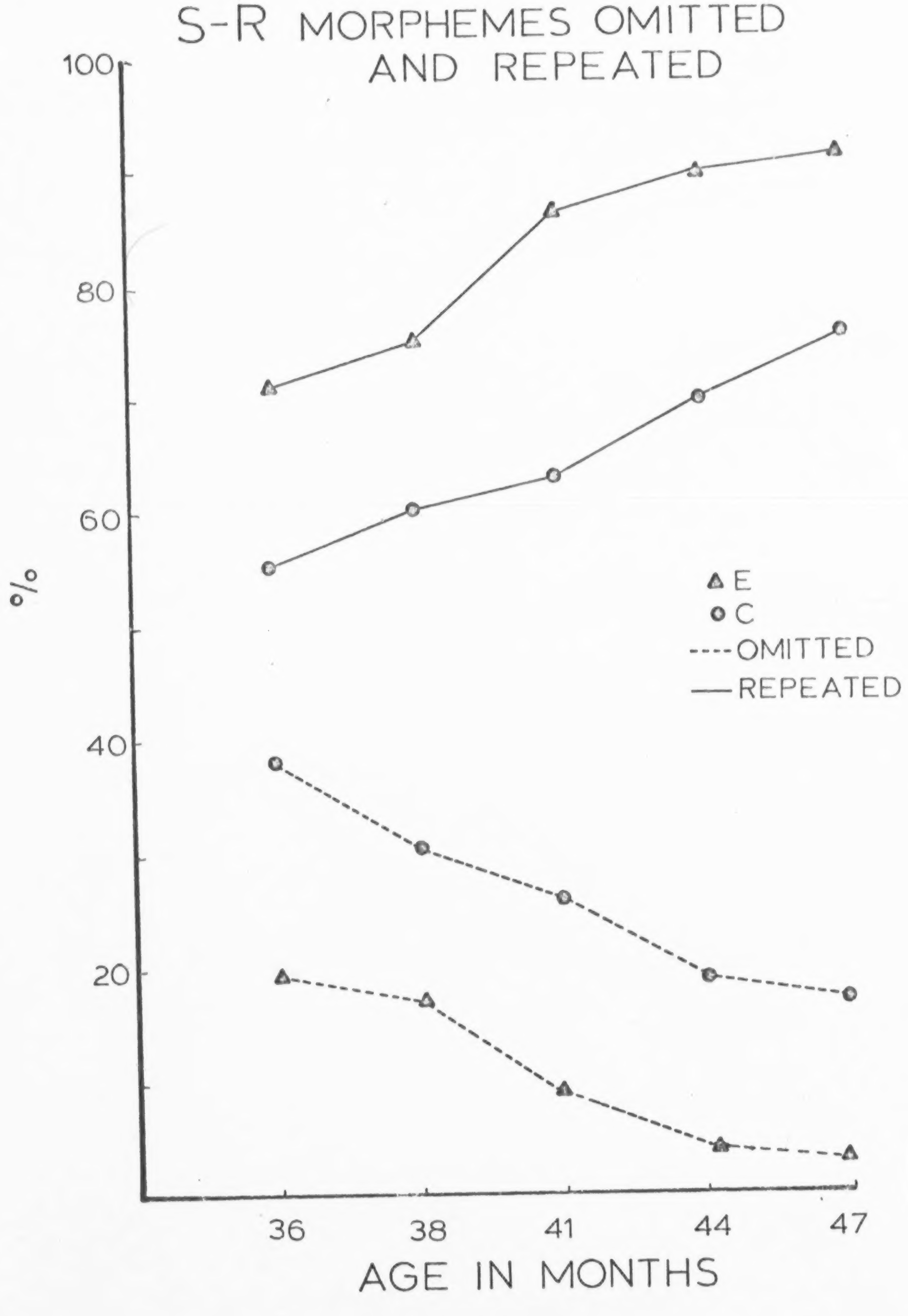

S-R MORPHEMES OMITTED AND REPEATED
100
80
60
40
20
%
E
C
----OMITTED
—REPEATED
36
38
41
44
47
AGE IN MONTHS

Figure 49

Since the items on the sentence repetition test were representative of clause types rather than of increasing degrees of difficulty, no predictions could be made on the subjects' performance on the individual sentences. Figures 50 and 51 illustrate the differential performance of the two groups on the sentences which have been ranked according to length in number of words. Figure 50 illustrates the average percentage of morphemes repeated for each of the sentence groups, while Figure 51 illustrates the average percentage of exact repetitions for each group of sentences. Although both the Experimental and Control Groups exhibited diverse performance within each sentence group, the general performance picture suggests that sentence length is a factor in the differential facility with which the groups repeated the sentences. The Experimental Group does show a clearly superior performance on every group of sentences when compared with the Control Group.

Discussion

The differential performance of the two groups, as measured by omission and exact repetition in terms of both whole responses and morpheme counts, seems to be conclusively demonstrated, even at this early stage. The results of the initial tests have been replicated in the later ones, with the Experimental subjects not only performing more efficiently on single tests but also manifesting a higher and steadier rate of improvement through the five age levels so far tested. In a general way, this indicates a higher level of linguistic maturity among the Experimental subjects as a group. Whether their ability to correctly imitate most of the syntactic structures on this test may be taken to imply a corresponding ability to comprehend and spontaneously produce these structures remains to be proved by other tests, since previous literature does not seem to have resolved this question. Slobin (1967) seems to be convinced that the ability to imitate indicates as well the ability to comprehend and produce the utterances imitated. Others, however, maintain that children are able to imitate structures they do not understand (Fraser, Bellugi, and Brown, 1963; Lovell and Dixon, 1967). It is clear, however, that at least some of the items in this test have been understood by the subjects, even though they are not always correctly repeated. For instance, one of the sentences least often correctly repeated, "Does Mary have a sister?" (No. 17) very often elicits a reply ("Yeah," or "No, she got a brother") instead of an imitation. The imitative response to the sentence, when it does come, is more often than not "Do Mary have a sister?" Another instance of incorrect repetition showing evidence of recoding is "Dump trucks and garbage trucks they're real big" for "Dump trucks and garbage trucks are real big" (No. 10).

This raises, therefore, the particularly difficult question of how much dialectal influence has to be reckoned with in tests of linguistic competence, especially when the subjects are black children. Recent studies (Osser, Wang, and Zaid, 1969; Nurss and Day, 1971) have shown that when nonstandard English dialect features are taken into consideration, the scores on linguistic competence tests of lower-status black

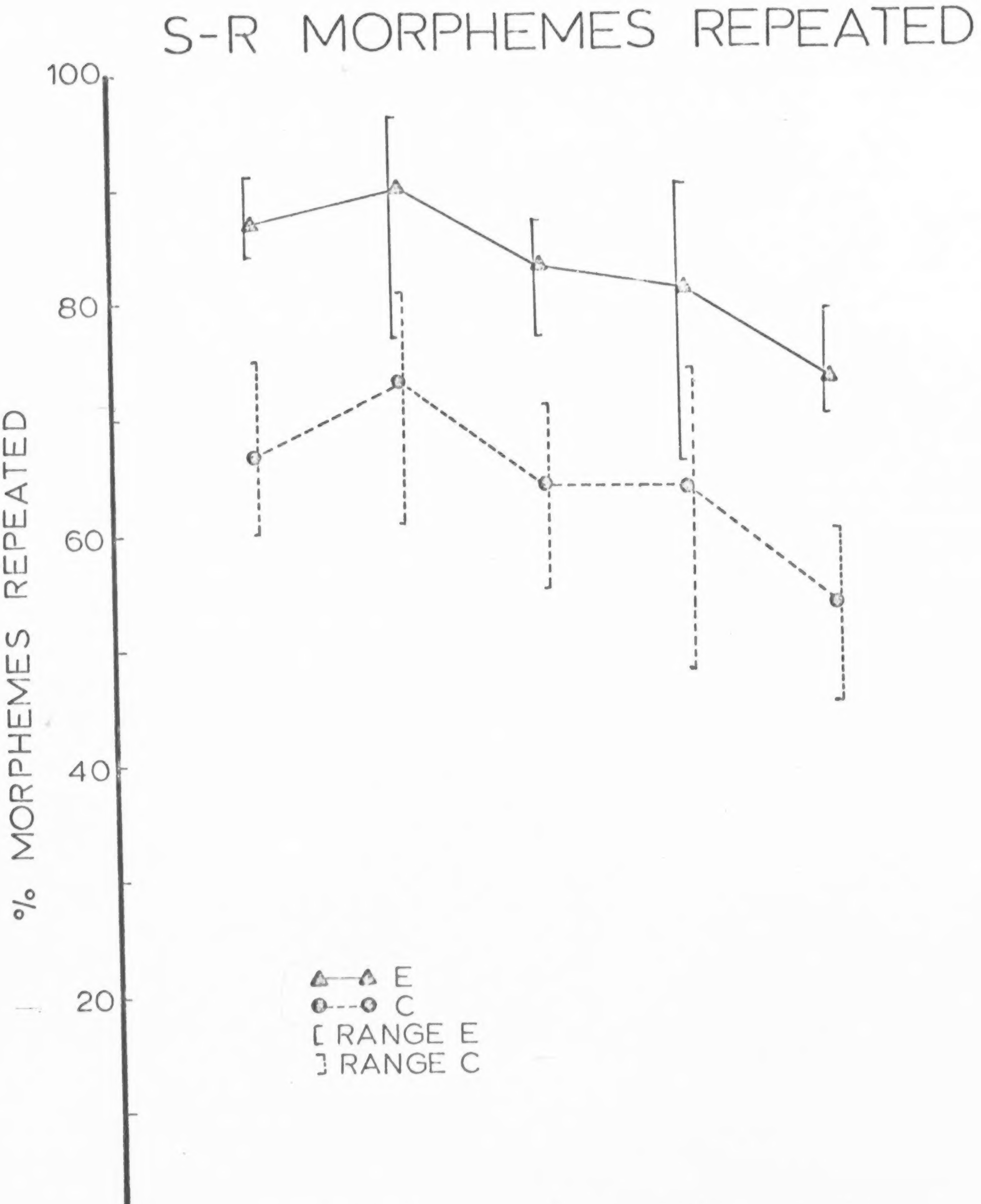

S-R MORPHEMES REPEATED
% MORPHEMES REPEATED
100
80
60
40
20
4
5
6
7
8
NUMBER OF WORDS IN SENTENCES
△—△ E
○---○ C
[RANGE E
] RANGE C

Figure 50

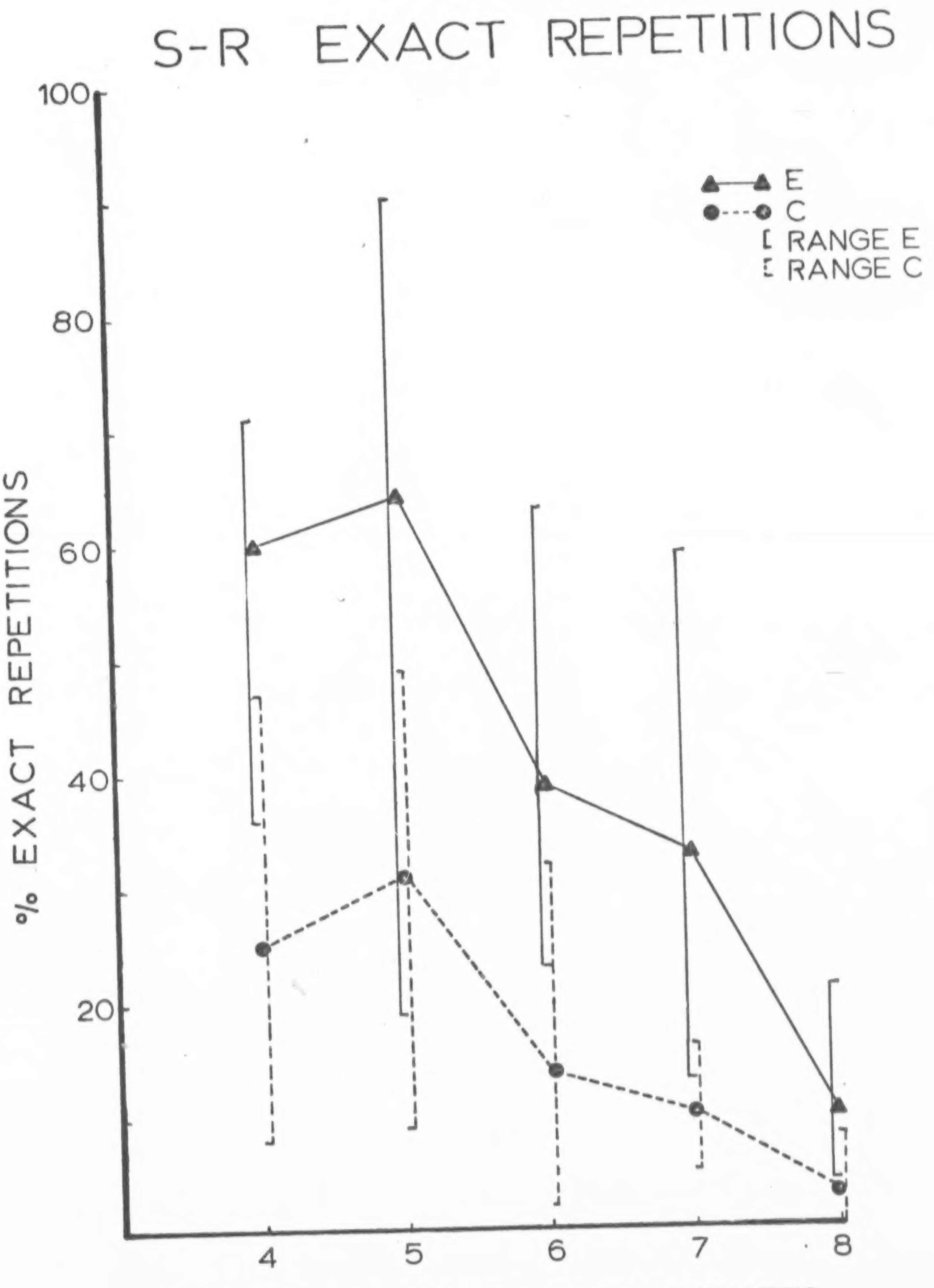

S-R EXACT REPETITIONS
100
80
60
40
20
% EXACT REPETITIONS
E
C
RANGE E
RANGE C
4
5
6
7
8
NUMBER OF WORDS IN SENTENCES

Figure 51

and white children improve significantly. It is possible that dialect features may account for the greater number of substitutions in the responses of the Control subjects; they may in fact account for a great many omissions too, since some of the known Black English dialect features consist of the omission of certain function words and terminal markers. However, since both subject groups in the present study consist of black children from the same neighborhood, they have most likely been exposed to the same dialectal influences, the only difference being that the Experimental subjects are participating in an educational stimulation project and are probably involved in more meaningful communication with speakers of Standard American English. The types of deviations observed to have been made by the children in both groups seem to suggest that there is very little dialectal variation, if at all, between the two groups, and that adjusting the scores to accommodate dialectal patterns would probably raise the scores of both groups but would not substantially alter their differential performance. The matter, however, needs to be looked into, and the answer to the question of whether dialectal factors may have distorted the results of the study cannot be arrived at until a detailed qualitative analysis of the responses of both groups has been made.

In spite of the lack of information in regard to the factors of length and syntactic complexity, the results of the sentence repetition test can be taken as an estimate of children's linguistic competence. The performance of the Experimental children tended to reflect their generally superior language facility.

Sentence Repetition Test II

Although the results of the present Sentence Repetition Test have shown measurable differences between the overall performances of the experimental and the control subjects, the qualitative differences have been difficult to describe because of the following deficiencies of the test:

1. The 34 sentences given have been described as representing "Gleason's 16 sentence types" (Gleason, 1965; actually, Gleason's discussion is based on Roberts, 1961) and their transformations. Most of the sentences, however, are not pure examples of these types (e.g., double adjectives, which complicate the structure considerably, are present in many instances); moreover, not all the types represented have their corresponding transformations.

2. Since these "sentence types" are classified according to the kind of verb used rather than clause structure, their levels of difficulty have not been made clear. Consequently, it has not been possible to make hypotheses or predictions concerning the subjects' performance on the different items in the test.

3. Generally, the shorter sentences in the test are also structurally the simpler, and the longer the more complex; hence it is difficult to determine the degree to which either length or structural com-

plexity influences the subjects' performance.

4. The distribution of sentence lengths, complexities, transformations, etc., is uneven; e.g., there are considerably more 5-, 6-, and 7-word sentences than either 4-word or 8-word sentences.

A new Sentence Repetition Test (to be given to subjects 60 months and over) has therefore been devised to check the accuracy and refine the findings of the SR test now being given to the younger subjects. It has been designed to provide the following controls lacking in the first test:

1. Length. There will be 13 six-word, 13 seven-word, and 12 eight-word sentences. (Total = 38 sentences)

2. Complexity. A measure of complexity has been arrived at by counting the number of transformational steps from the kernel (based on the assumption that a kernel sentence is less complex than any of its transformations). Thus a passive is counted as one transformation; a yes/no question without do as one; a yes/no question with do as two transformations; a yes/no with do and wh- as three, and so forth. In addition to these step-by-step transformations, sentences with compounds have been included, since one of the sentences in the last test with which the subjects seemed to have the greatest difficulty contained a compound subject. Sentences with embedded clauses were also included because the only sentence with clause embedding in the last test proved one of the most difficult for the subjects.

(Note: Another source of difficulty in the last test, the use of adjectives, has not been given special attention here, since it is not easy to control the length of sentences containing varying degrees of modification. It may be advisable to devise another test to investigate this particular problem.)

The design of the proposed SR Test is as follows:

Distribution of sentences according to length and complexity

LENGTH (words)	COMPLEXITY					
		Transformations				
	Kernel	1-step	2-step	3-step	Compound	2-clause
6	2	2	3*	2	2	2
7	2	2	3*	2	2	2
8	2	2	2	2	2	2

*A sentence with yes/no + does has been added to each of these categories.

Test Sentences

A. Mary and Fred are going to the movies.
B. That is the house Jack built.

1. Does the car come down the street?
2. Jack and Terry built that house.
3. What does the dog chase around the block?
4. Five cars and four trucks are coming.
5. Why was the letter sent back by John?
6. The house Jack built burned down.
7. He likes the pictures he has painted.
8. How do cars come down the street?
9. Has he painted most of the pictures?
10. I was laughed at this morning.
11. John sent back the letter to the girl.
12. They laughed at me this morning.
13. Which of the pictures did he paint?
14. Does the dog chase the cat?
15. I was not laughed at this morning.
16. Was that house built by Jack?
17. They laughed when I sat down.
18. Have most of the pictures been painted?
19. Jack built that house last year.
20. The cars are coming down the street.
21. John sent the girl back the letter.
22. Is the cat being chased by the dog?
23. What did Jack build last year?
24. Does he paint most of the pictures?
25. Did you say five cars were coming?
26. They looked at me and laughed.
27. Who was laughed at this morning?
28. The dog chases the cat and the rabbits.
29. That house was built by Jack.
30. John sent back the letter and the present.
31. I know why John sent back the letter.
32. The cat the dog chased ran away.
33. He has painted and sold the pictures.
34. The dog chases the cat around the block.
35. Are the cars coming down the street?
36. The letter was sent back to the girl.
37. He has painted most of the pictures.
38. The cat is being chased by the dog.

MEASURING LANGUAGE DEVELOPMENT WITH THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES

Introduction

The Illinois Test of Psycholinguistic Abilities (ITPA) was devised by Kirk and McCarthy (1961, revised 1968) to measure the various encoding and decoding abilities of early linguistic behavior. The ITPA model evaluates these abilities through measurement of the interaction of three effects on that behavior: (1) level of organization, (2) psycholinguistic process, and (3) channels of communication. There are two levels of organization: the representational and the automatic. The first subsumes those processes which require a high degree of voluntary activity, while the second includes the more habitual and mechanized processes of arranging and reproducing linguistic phenomena. There are three processes: the receptive, the expressive, and the organizational. These respectively include the abilities to: (1) recognize and understand linguistic phenomena, (2) express concepts synthesized from that understanding, and (3) internally manipulate those concepts. The two channels of communication used in the test relate to the routes of communication. Though it is theoretically possible to postulate many such channels, the ITPA restricts its observation to the auditory-vocal and visual-motor channels. The design of the ITPA is that each of its several subtests measure one process through one channel at one level of organization.

Originally the ITPA was developed to measure the rate of linguistic development in retarded and disadvantaged or "culturally-deprived" children, and it has been widely used in this context since its inception. Most recently it has been used to measure the effects of specific curricula on the intellectual growth of disadvantaged preschool children (Rentfrow, 1971) Our concern in this context is to provide some standardized measure of differential language development in a group of preschool age children who are speakers of nonstandard English.

Method

Subjects: The subjects consisted of 15 children between 4-6 and 4-10 years of age involved in the Family Rehabilitation Project. The project is being carried out under the direction of the University of Wisconsin's Research and Training Center in Mental Retardation.

All of the children in the project were selected from a population of newborn progeny from mothers with IQ's of 80 or below who were of low socio-economic status. The group was divided into experimentals (E) and controls (C), with the experimentals participating in a daily structured preschool educational program. The control children do not participate in the daily program but are periodically tested. The group consisted of 10 E's and 5 C's. The study is ongoing.

Instrument and Procedure: All subjects took the ten basic subtests of the ITPA. The procedure for administration was followed exactly as given in the *Examiner's Manual* (revised edition, 1968).

Scoring:

For both the E and C groups the following data were calculated:

(1) mean scaled score (MSS): The MSS is derived by averaging the scaled scores of all the subjects in a particular group. Scaled

scores for individuals are derived according to tables in the examiner's manual by adjusting the raw scores of each of the subtests to eliminate age as a factor.

(2) psycholinguistic age (PLA): The group PLA is derived by averaging the individual PLA's for all members of the group. The individual PLA represents the level of overall linguistic skill attained by the child. Comparing PLA with the chronological age (CA) shows whether the child is above or below average.

(3) psycholinguistic quotient (PLQ): The PLQ for a group is derived by averaging the PLQ's of the individuals within the group. The individual PLQ is derived by dividing the PLA by the CA and multiplying the result by 100. In terms of linguistic ability, the PLQ is comparable to an IQ.

Results:

A composite of the means of each of the measures derived for each of the groups (E and C) may be found in Table 36.

TABLE 36

RESULTS OF EACH GROUP'S PERFORMANCE ON THE ITPA

	Mean CA	Mean PLA	MSS	PLQ
Experimental	4-8	5-3	41.0	112.8
Control	4-7	3-9	31.7	82.1
Difference		1-6	9.3	40.7

An examination of the means indicates that the children in the Experimental group appear to have a much higher degree of linguistic sophistication than do those in the Control group. In terms of psycholinguistic ability as measured by the test, the E group is performing a full year and a half ahead of the controls. Furthermore, there is a 40 point discrepancy in the PLQ score in favor of the E group. The experimentals are performing, on the average, seven months above their mean CA, while the controls are ten months behind their mean CA. The data presented in Table 37 represent the scaled scores for both the E and C groups on each of the ten main subtests is also indicated in this table. Figure 52 illustrates the performance of each group on each subtest and their performance in relation to the group's mean scaled score. It is obvious from the differences listed in Table 37 and the illustration of the scaled scores in Figure 52 that the experimental group performed better on every single subtest than did the controls. The greatest discrepancy in performance appeared on the

ITPA SUBTEST RESULTS

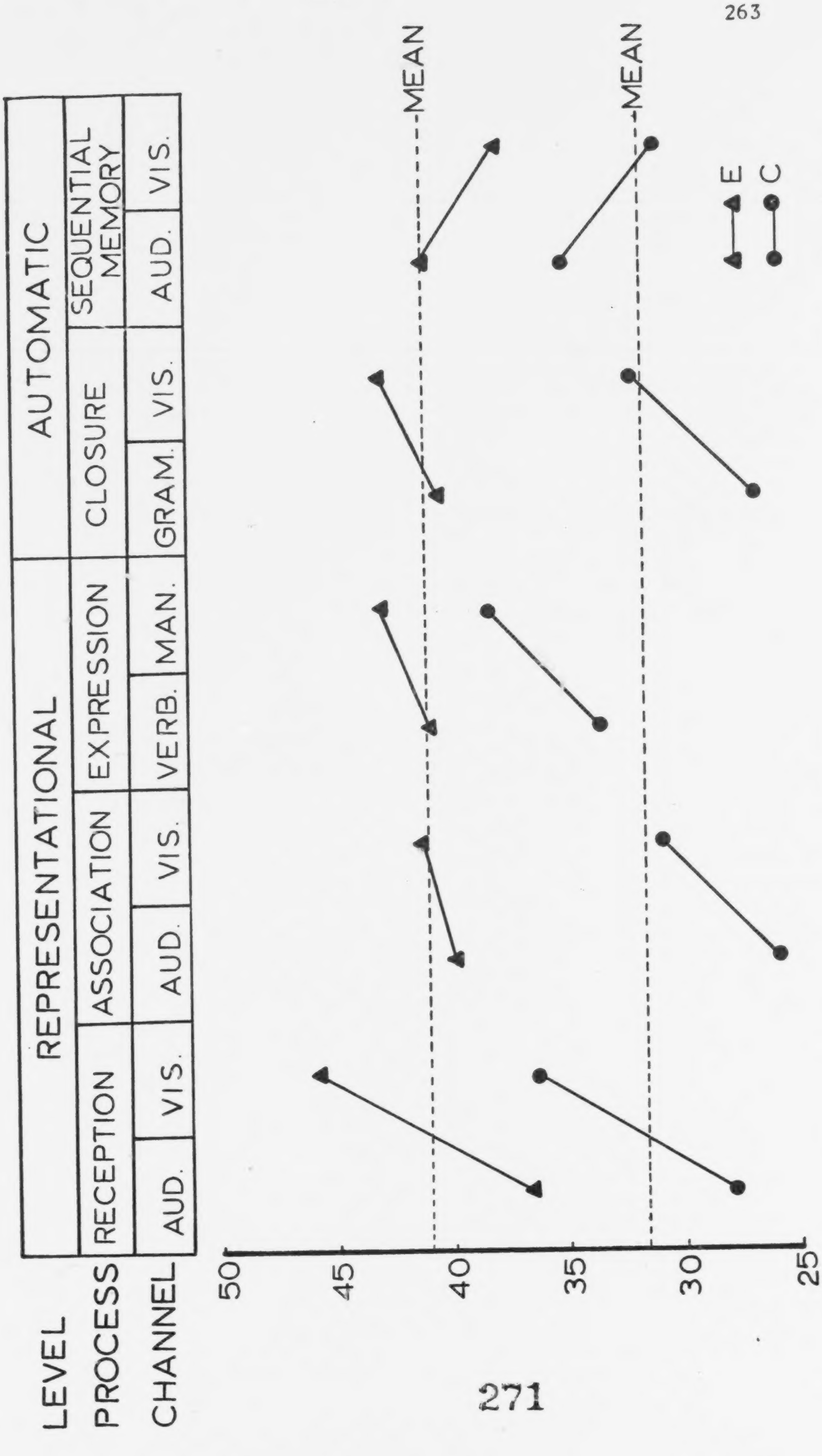


Figure 52

tests for Auditory Association and Grammatic Closure (respectively, 14.0 and 13.7) and the least difference on the tests for manual expression and auditory sequential memory (respectively, 5.3 and 6.0).

By using the grid in the upper part of Figure 52 one can compare the performance of each group for the auditory-vocal and visual-motor channels on each process at each level. Except for the subtests of sequential memory, both groups scored higher on tests involving the visual-motor channel than they did on tests in the auditory-vocal channel.

TABLE 37

RESULTS OF EACH GROUP'S PERFORMANCE ON THE SUBTESTS OF THE ITPA

	E	C	(E-C=diff.)
Auditory Recpt.	36.6	27.8	+8.5
Visual Recpt.	45.8	36.4	+9.4
Auditory Assc.	39.8	25.8	+14.0
Visual Assc.	41.2	30.8	+10.4
Verbal Exp.	40.8	33.6	+7.2
Manual Exp.	43.5	38.2	+5.3
Grammatic Clos.	40.5	26.8	+13.7
Visual Clos.	43.0	32.0	+11.0
Auditory Sequen.	41.0	35.0	+6.0
Visual Sequen.	37.9	31.0	+6.9

Table 38 specifically indicates these differences. On tests in the auditory-vocal channel, the experimentals functioned 2.6 points less well than they did on similar tests in the visual-motor channel. The difference for the controls was 3.9. When the tests for sequential memory are removed from consideration, the differences widen to respectively 4.0 and 5.9.

TABLE 38

RESULTS OF EACH GROUP'S PERFORMANCE ON AUDITORY-VOCAL SUBTESTS AS COMPARED WITH VISUAL MOTOR SUBTESTS OF THE ITPA

	Experimental	Control
Auditory-Vocal	39.7	29.8
Visual Motor	42.3	33.7
Auditory-Vocal (Minus tests for sequential memory)	39.4	28.5
Visual Motor (Minus tests for sequential memory)	43.4	34.4

Discussion

Obviously, the Experimental group's performance is far superior to the Control group, across all of the subtests of the ITPA. Indeed, one must assume that the effects of the early intervention program on the Experimentals has facilitated their linguistic proficiency, especially in skills measured by the test. The type of intervention program implemented, with considerable emphasis on verbal expressive behavior, has an extremely positive influence on language development in disadvantaged children. There are, however, some reservations in such an interpretation. What we must wait upon is the results of these children's future performances. In other words, first it remains to be seen whether the high scores obtained by the experimentals on the ITPA will actually predict future proficiency in their learning reading and other language skills. Such studies as those by Rosenfield (Personal Communication) and Mehrabian (Personal Communication) suggest the ITPA has low predictive power in this area.

Secondly, high performance indicated by the scores obtained by the experimentals may not be much higher than the average scores for the population as a whole. If we measure the mean scaled score of the experimentals against the mean of the normative group (36 with a standard deviation of 6), it would seem that the experimentals are functioning with extremely high linguistic proficiency and that the controls are just inside the boundary the designers of the test set to indicate functional retardation. In making such a comparison, however, one should keep in mind that national IQ's are rising (Severson and Guest, 1970) and that recent use of the ITPA has reported scores generally higher than thought to be in the normal range (Whitcraft, 1971). It would appear, therefore, that in terms of psycholinguistic abilities in the general population, the controls are functioning worse than the figures would suggest and that the experimentals are functioning close to average.

Thirdly, the composite scores MSS, PLA, and PLQ do not give an accurate reflection of the diverse performances within and between the groups reflected on the individual subtests. An exmaination of the subtest results in Tables 2 and 3 leads to some generalizations which cannot be inferred from the composite scores. The two most important generalizations are that: (1) the experimentals may have to some extent gained proficiency in standard English as a result of the intervention program, and (2) the ITPA may be, on some subtests, weighted in favor of speakers of standard English and against speakers of at least some varieties of nonstandard English, in this case, Black English.

By way of comparison with the results of the Whitcraft (1971) study, her results and ours are quite comparable. In fact, some major differences in ITPA subtest scores between her standard speakers of English and nonstandard speakers are approximately the same as the differences between the experimentals and controls in this study. If such is the case, and the comparison has validity, then it implies that the experimentals may be functioning better than the controls on some of the subtests, at least, because the environmental stimulation has given them some facility of fluency in standard English. Obviously, an additional implication is that this fluency has enabled them to score higher than the controls on certain subtests precisely because of the nature of the ITPA's standardization procedure; i.e. the use of a population of speakers of standard English. However, such a comparison does not necessarily lead to the suggestion that the experimentals have become fully bi-dialectical. Although the experimentals exhibit the most marked superiority over the controls on those tests calling for specific skills in standard English morphology and syntax, they still score lower on those specific subtests than their mean. (See Figure 52.) Furthermore, such a one-sided implication is totally unfair to the experimentals, since the controls have had considerable exposure to the standard English dialect through radio and television. However, although the experimentals' daily situation contains speakers of both dialects as well as television, it is probably necessary for them to actively communicate with standard English speakers, communication which goes beyond the passive entertainment of television.

Whitcraft found an overall difference of 6.7 in MSS between standard and nonstandard speakers of English (standard MSS=44.3; nonstandard MSS=37.6), not as large as the 9.3 overall MSS difference between experimentals and controls in this experiment. Her data also suggests that although nonstandard speakers scored lower on each single subtest, their lowest scores relative to the standard speakers result on tests involving the auditory-vocal channel, notably the tests for auditory association and grammatic closure (auditory association: standard SS=43.7, nonstandard SS=32.9; grammatic closure: standard SS=46.3, nonstandard SS=32.9). On tests outside the auditory-vocal channel, the differences were less marked, most notably on the test for manual expression (standard SS=44.8, nonstandard SS=43.7). The differences in Table 39 are in part very similar to those just cited. The greatest difference between experimentals and controls results on the same subtests where Whitcraft found the greatest difference between her standard and nonstandard speakers, the tests for auditory association and grammatic closure (auditory association: E MSS=39.8, C MSS=25.8; grammatic closure: E MSS=40.5, C MSS=26.8). The least difference in Table 39 is found for the same subtest on which Whitcraft found the least difference between her two groups, manual expression (manual expression: E MSS=43.5, C MSS=38.2). One may also notice in Table the marked similarity in the degree of difference between the groups studied in each experiment, for Whitcraft's standard and nonstandard speakers of English and for our E and C groups.

TABLE 39

DIFFERENTIALS ON TWO ITPA SUBTESTS BETWEEN
STANDARD AND NONSTANDARD SPEAKERS OF ENGLISH AS COMPARED WITH
THE SAME DIFFERENTIALS FOR E AND C GROUPS

	Whitcraft	Table
Auditory Association	13.5	14.0
Grammatic Closure	13.4	13.5

The remarkable consistency between these results suggests, perhaps, that at least some percentage of the learning produced by the controlled environment of the experimentals has contributed to their demonstrated ability to understand standard English better than most speakers of the native Black dialect. Though it is unreasonable to say that the experimentals have become bi-dialectical, it is reasonable to assume that a percentage of this linguistic superiority, as compared to the controls, is attributable to the fact that the ITPA was standardized on a sample of language which the controls have less contact with.

The more important conclusion derived from the subtest scores is that both the experimentals and the controls do more poorly, relative to their group mean scores, on tests requiring use of the auditory vocal channel. Table 37 indicates that, with the exception of the tests for sequential memory (repeating a sequence of numbers and picture symbols), both the experimentals and the controls perform significantly and consistently better on subtests involving the visual motor channel than they do on the subtests involving the auditory-vocal channel. (Excluding the subtests for sequential memory, the experimentals score 4.0 points higher on the visual motor channel, while the controls score 5.9 points higher.) This finding strongly reinforces the theory that cultural background, in this case, linguistic background, may have a very large effect upon performance on the ITPA (Severson and Guest, 1970). It also lends support to Whitcraft's contention that the test, at least in part, is weighted in favor of subjects from standard English backgrounds. Table 38 gives the average scaled scores for the auditory-vocal and visual motor channels for both groups as well as those averages minus the scores for the sequential memory tests. This data indicates that both the experimentals and controls do better on tests in the visual-motor channel. Perhaps it may be unwarranted to attribute this discrepancy to any single factor, but the bulk of evidence gathered in this paper tends to suggest that were the ITPA not predicated on standard English as a normative medium, the children in both groups would have higher scores.

Nevertheless, in terms of measuring the success of the intervention program, the subtest results clearly indicate that the experimentals score consistently higher, even on tests in the auditory-vocal channel. Had the test been standardized to include speakers of nonstandard English, both groups might possibly do better, but the gap between experimentals and controls would probably not diminish significantly. An examination of Figure 52 indicates that both when the dialect factor is present (auditory-vocal channel) and when it is removed (visual-motor channel), the experimentals show a more remarkable development of linguistic skill compared to the controls. Thus, the discrepancies found in both groups between performance on the auditory-vocal channel as compared to the visual-motor channel would not significantly diminish the conclusions revealed by the general pattern of results: principally, that the intervention program has facilitated the language performance of the experimentals to the extent of a 40-point PLQ difference over the controls. The magnitude of this differential is substantial, and probably would withstand the objections to the ITPA presented in this paper, should they be thoroughly and completely valid. We have discussed these objections in some detail precisely because the differential between the two groups is so large that it engenders the necessity to discuss the possible limitations of our instrument. We have found evidence suggesting the need for improvements in the ITPA, but not evidence which would reduce its evaluative power, i.e. in so far as it was used in this experiment. Only by future testing of these children will we be able to discover if the wide differences in linguistic skills exhibitied between experimentals and controls in this study predict corresponding differences in the acquisition of reading and other language skills. Such tests will be valuable not only in assessing the progress of both groups, but also in further evaluating the ITPA as a measurement of psycholinguistic skill.

SUMMARY OF LANGUAGE DEVELOPMENT

The results of the various tests we have used to measure facility in language production, imitation and comprehension are basically similar. The children of the Experimental group demonstrate superiority in each of the three areas over the Control group children. The earliest measure used is that of gross feature tabulation of free speech. The results of these measures show that in the crucial period of rapid language growth (from 18 to 35 months) the experimental children lead the control children in the entire area of speech production--they use more lexical items in more utterances. This does not mean, of course, that the children of the control group are unable to speak; on the contrary, by the age of three the control children are using as many utterances as the Experimentals. At this same age level, however, the Experimental children are more than a year ahead on a longitudinal scale of mean length of utterances which is the clearest index of language production development. The results in the area of imitation are similar, pointing to a year's difference in sentence repetition ability between the groups. By the age of four the number of exact repetitions in the sentence repetition test by the control group is roughly equal to that of the experimentals at the age of three. In the area of comprehension the developmental difference between groups is even greater. The mean score of the Control group (30.3) at four and a half is comparable to the mean score of the Experimental group (32.9) a year and a half earlier.

In addition to the consistency of these measures further evidence on the children's differential language development is given by the results of a standardized instrument, the Illinois Test of Psycholinguistic Abilities. According to these results at CA 4-8 the mean psycholinguistic age of the Experimental group is a year and a half greater than that of the Control group.

In the coming year the Language Laboratory will continue to assess the linguistic development of the children of the Milwaukee Project and will do wider research on its assessment techniques and instruments. Gross feature tabulation will continue for all subjects' free speech samples. In addition, free speech samples will be further analyzed by the use of the Scale of Children's Clausal Development (Dever & Bauman, 1971). The use of this scale will aid in the assessment of the acquisition of syntax thus far not measured by gross feature tabulation. A new sentence repetition test will be devised and administered to all the children age five and above. This test will research the components of language imitation ability controlling for length in words versus differing syntactic complexities. Both the new and the old sentence repetition tests will be given to other populations of children. This will allow for comparison with the Milwaukee Project children and possible standardization of these tests. The grammatical comprehension test will continue to be given to the children in Milwaukee. A new form of the G-C test concentrating on the various syntactic constructions of the predicate verb and imbedded sentences will also be administered. Both these forms of the Grammatical Comprehension Test will be given to other populations of children as well. The Berko Test of English Morphology and an additional test of morphology will be administered to the children of the Milwaukee project and other populations to measure the morphological component of their grammars. The use of the ITPA as a standardized measure of language development will continue for all the children in the Milwaukee Project.

The use of all these various measures will not only add to our knowledge of the linguistic development of the children of the Milwaukee project but also to the acquisition of language by children in general.

REFERENCES

Bacharach, V. R., and Kellas, G. Phrase versus base structure effects on short-term retention. Journal of Verbal Learning and Verbal Behavior, 1971, 10, 171-175.

Berko, Jean. "The Child's Learning of English Morphology". Word, 1958, XIV, 150-177.

Brown, R., and Bellugi, U. Three Processes in the Child's Acquisition of Syntax. Harvard Educational Review, 1964, 34, 133-151.

Brown, R., Cazden, C. B., and Bellugi-Klima, U. "The Child's Grammar from I to III". In J. P. Hill (ed.), Minnesota Symposium on Child Psychology, Minneapolis, Univ. of Minn. Press, 1969, Vol. 2., 28-73.

Carroll, J. B. Determining and Numerating Adjectives in Children's Speech. Child Development, 1939, 10, 215-229.

Cazden, Courtney B. The Acquisition of Noun and Verb Inflections. Child Development, June, 1968, 39(2).

Cazden, Courtney B. The Neglected Situation in Child Language Research and Education. In F. Williams (ed.), Language and Poverty, Chicago, Markham Publishing Company, 1970, 81-101.

Chomsky, Carol. The Acquisition of Syntax in Children from Five to Ten. Cambridge, The M.I.T. Press, 1969.

Chomsky, N. Formal Discussion. In U. Bellugi and R. Brown (eds.), "The Acquisition of Language", Monographs of the Society for Research in Child Development, 1964, XXIX, 35-39.

Entwisle, D., and Greenberger, E. Differences in the Language of Negro and White Grade-School Children. U. S. Office of Education Grant No. 2-7-061610-0207, The Johns Hopkins University, Center for the Study of Social Organization of Schools, Baltimore, Maryland, 1968.

Ervin-Tripp, S. M., and Slobin, D. I. Psycholinguistics. Annual Review of Psychology, 1966, XVII, 435-474.

Flavell, J. H., and Hill, J. P. Developmental Psychology. Annual Review of Psychology, 1969, XX, 1-56.

Fraser, C., Bellugi, U., and Brown, R. Control of grammar in imitation, comprehension and production. Journal of Verbal Learning and Verbal Behavior, 1963, II, 121-135.

Gleason, H. A., Jr. Linguistics and English Grammar. New York, Holt, Rinehart, and Winston, Inc., 1965.

Graham, N. C. Short term memory and syntactic structure in educationally subnormal children. Language and Speech, 1968, 11, 209-219.

Hunt, Kellogg W. Syntactic maturity in school children and adults. Monographs of the Society for Research in Child Development, 1970, XXXV, p. 1.

Kelly, Edward J. "The New Nursery School Project: Evaluating the Effectiveness of an Open, Responsive Environment in Achieving Selected Objectives of Early Childhood Education, Final Report", Office of Education Document #ED042518, Washington, D.C., 1969.

Kessel, F. S. The role of syntax in children's comprehension from ages six to twelve. Monographs of the Society for Research in Child Development, 1970, XXXV, p. 6.

Kirk, S. A., and McCarthy, J. J. The Illinois Test of Psycholinguistic Abilities: An approach to differential diagnosis. American Journal of Mental Deficiency, 1966, 399-412.

Loban, W. D. The Language of Elementary School Children. Champaign, Illinois, National Council of Teachers of English, 1963.

Lovell, K., and Dixon, E. M. The growth of the control of grammar in imitation, comprehension, and production. Journal of Child Psychology and Psychiatry, 1967, 8, 31-39.

Martin, E., and Roberts, K. H. Grammatical factors in sentence retention. Journal of Verbal Learning and Verbal Behavior, 1966, 5, 211-218.

Matthews, W. A. Transformational complexity and short-term recall. Language and Speech, 1968, 11, 120-128.

McCarthy, D. A. Language Development in Children. In L. Carmichael (ed.), Manual of Child Psychology (2nd edition). New York, Wiley, 1954, 492-630.

McNeill, D. "Developmental Psycholinguistics". In F. Smith and G. A. Miller (eds.), The Genesis of Language, Cambridge, Massachusetts, M.I.T. Press, 1966, 15-84.

Mehler, J. Some effects of grammatical transformations on the recall of English sentences. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 346-351.

Mehrabian, Albert. "Measures of Vocabulary and Grammatical Skills for Children up to Age Six" United States Public Health Service Grant MH 13509.

Menyuk, P. A preliminary evaluation of grammatical capacity in children. Journal of Verbal Learning and Verbal Behavior, 1963, 2, 429-439.

Nurss, J. R., and Day, D. E. Imitation, comprehension, and production of grammatical structures. Journal of Verbal Learning and Verbal Behavior, 1971, 10, 68-74.

Osser, H., Wang, M. D., and Zaid, F. The young child's ability to imitate and comprehend speech: a comparison of two sub-cultural groups. Child Development, 1969, 40, 1063-1075.

Paraskevopoulous, John N., and Samuel A. Kirk. The Development and Psychometric Characteristics of the Revised Illinois Test of Psycholinguistic Abilities. Urbana, University of Illinois Press, 1969.

Parker, R., Ambron, S., Panulson, G., Halbrook, M. and Levine, J. An Overview of Cognitive and Language Programs for 3, 4 and 5 year old Children. Compiled by Southeastern Education Laboratory, 1970.

Perozzi, Joseph A., and LuVern H. Kunze. Relationship between speech sound discrimination skills and language abilities of kindergarten children. Journal of Speech and Hearing Research, 1971, XIV, No. 2, 382-390.

Rentfrow, Robert K. "Intellectual and Language Development of Disadvantaged Children in Three Preschool Curriculum Models". Unpublished paper presented to the 1971 Annual Meeting of the American Educational Research Association, New York City, February, 1971.

Rosenfield, Abby G. "Psycholinguistic Abilities as Predictors of Reading Ability and Disability -- How Valid is the ITPA?" Personal communication.

Savin, H. B., and Perchonock, E. Grammatical structure and the immediate recall of English sentences. Journal of Verbal Learning and Verbal Behavior, 1965, 4, 348-353.

Sigel, Irving E., and Cereta Perry. "Psycholinguistic Diversity among 'Culturally Deprived' Children". American Journal of Orthopsychiatry, 1968, XXXVIII, No. 1, 122-126.

Slobin, D. I., and Welsh, C. A. Elicited imitation as a research tool in developmental psycholinguistics. Reproduced by Educational Resources Information Center, 1967.

Stewart, W. A. "Urban Negro Speech: Sociolinguistic Factors Affecting English Teaching". In Shuy, R. W. (ed.), Social Dialects and Language Learning, Champaign, Illinois, National Council of Teachers of English, 1965.

Turner, E. A., and Rommetveit, R. "The Acquisition of Sentence Voice and Reversibility", Child Development, 1967, XXXVIII, 649-660.

Whitcraft, Carol Jones. "Levels of Generative Syntax and Linguistic Performance of Young Children from Standard and Non-standard English Language Environments", Unpublished Ph.D. Dissertation, Austin, University of Texas, 1971.

Summary and Overview of Preliminary Results

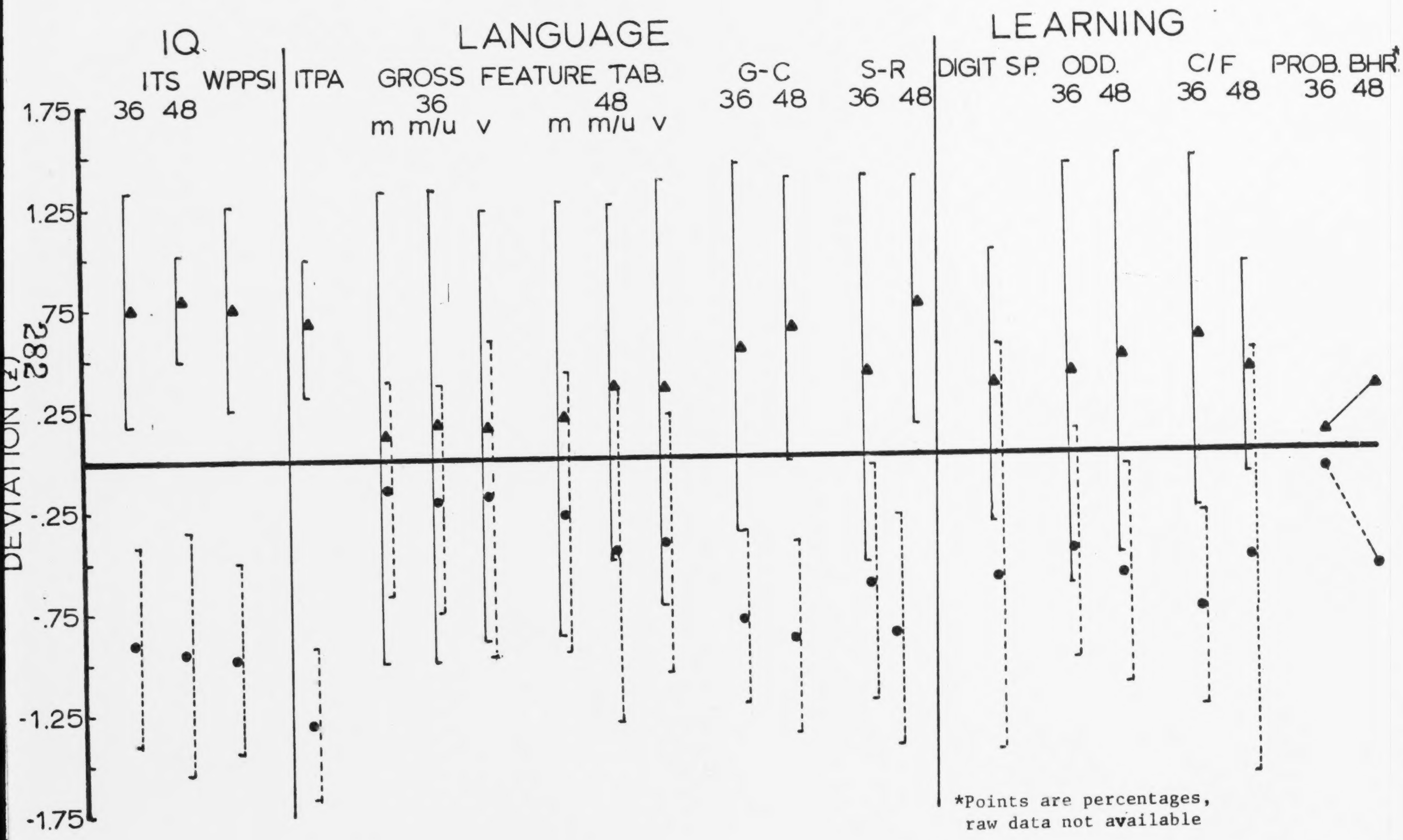
We have transformed a number of our developmental measures to two scores and placed them simultaneously on the same axis. This procedure facilitated an overview of the differential development of the two groups of children. Figure 53 has plotted 3 types of measures taken at 36 and 48 months: 1) IQ tests; 2) learning measures; and 3) language measures. These points reflect development over the most stable period for both groups in their performance and in our assessment procedures.

At thirty-six months, there is a thirty-one point difference in mean IQ performance in the two groups and at forty-eight months there is a twenty-nine point difference. This performance is reflected in the remarkable Z score deviations from the group mean performance baseline. Moreover, the deviations from the Z scores do not overlap in range, which supports the strength of the discrepancies in the IQ performance of the two groups. At 48 months, we administered the WPPSI and although the mean IQ scores are lower on this test than from Stanford-Binet (S-B) tests (as we pointed out earlier), there is a remarkable consistency to the differential performance of the two groups. This is demonstrated by comparison of the Z score values on the S-B at 36 and 48 months for the E and C groups: $Z_{E,36} = .75$ vs. $Z_{C,36} = -.92$; $Z_{E,45} = .79$ vs. $Z_{C,45} = -.95$; and for the WPPSI score at 48 months, $Z_{E,48} = .76$ vs. $Z_{C,48} = -.97$.

As we have already pointed out, the performance to date on the standardized tests of measured intelligence indicates a remarkable acceleration of intellectual development on the part of experimental Ss who have been exposed to the infant stimulation program.

Further, their performance is quite homogeneous as contrasted with that of the control group where only about one-fourth of the Ss test at or above the norms with the remainder trending toward subaverage performance.

There is reason for caution in the interpretation of such data because of the numerous pitfalls and hazards of infant measurement. Our experimental infants have had training on items fortuitously included in the curriculum which are sampled by the tests, while the repeated measurements have made both groups test-wise. The experimental group has benefited from an intensive training program to which no comparable group of infants has ever been exposed, to the best of our knowledge. We have tried very hard to answer whether it has been simply a matter of training and practicing specific skills. To some extent, infant intelligence tests must contain material which approximates material used in preschool curricula, primarily because of the limited variety of material for this age. Our other measures of performance tried to minimize the stock item and to gain additional insight into the performance of these children. As can be seen in the learning measures, the differential performance discrepancy is consistent with the IQ measures. Replication of the color-form preference and oddity discrimination show no trend toward a decrease



*Points are percentages, raw data not available

Fig. 53 COMPOSITE OF TRANSFORMED DEVELOPMENTAL MEASURES FROM THIRTY-SIX MONTHS

in difference between the experimental and control children. Indeed, there may be some suggestion for the opposite.

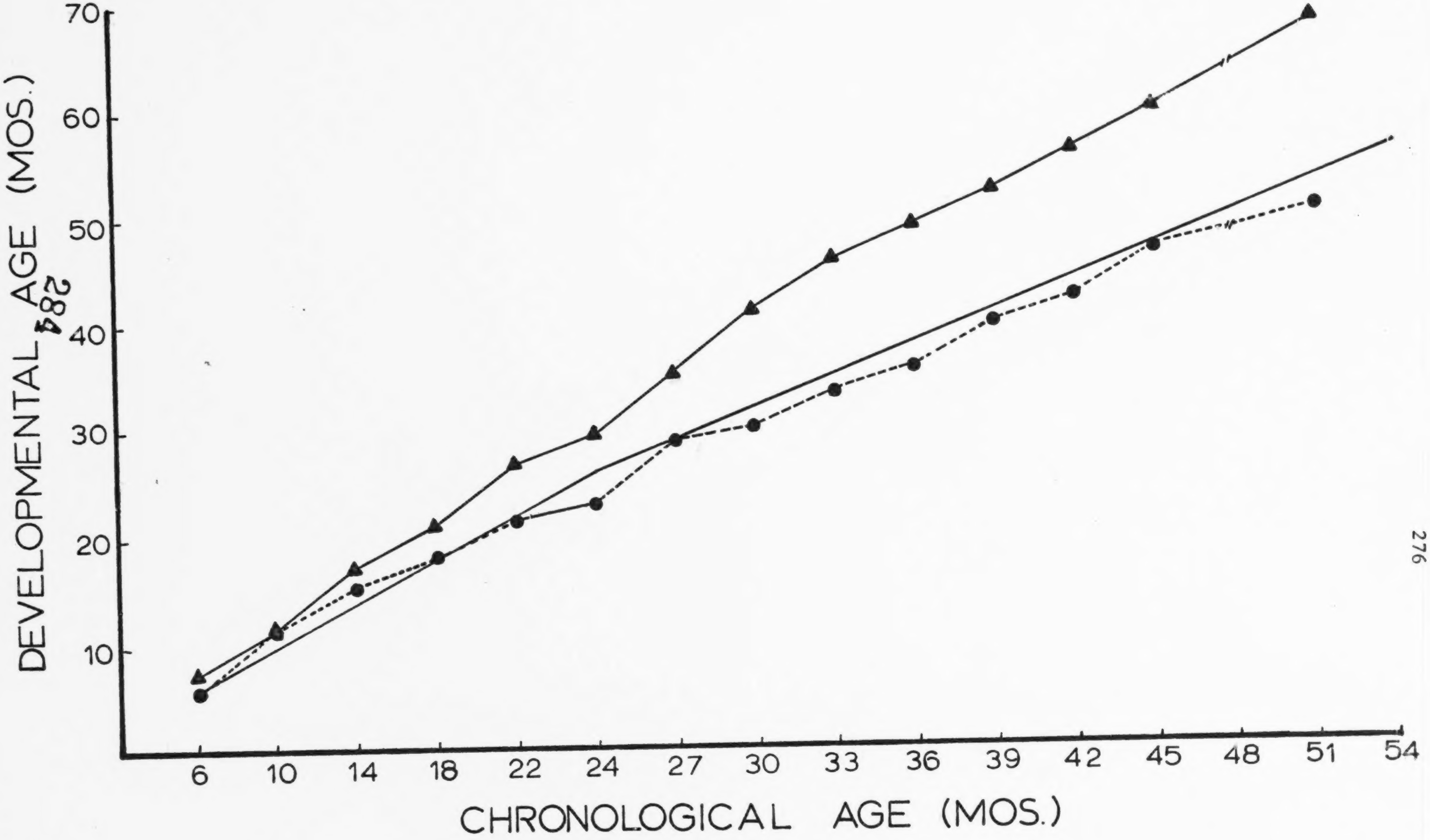
There is also a marked consistency in the performance of the two groups on the language measures. The experimental group remains at a superior performance level across all of the language measures. There is even an increasing difference in language performance between thirty-six and forty-eight months.

Although there is more variability in both the learning and language measures than on IQ performance, and less in language than in learning, there is an obvious consistency across all performance measures suggesting a stable, continued differential development -- in favor of the experimental children. In fact, the data in Figure 54, which is a plot of the mental age scores,in deviation form,through the entire course of development, underscore the highly remarkable consistency in the intellectual development between the two groups of children, in favor of the experimental children. For well over a year there has been maintained at least a one full year (12 months or more in MA) intellectual advantage of the experimental children over the control children.

Thus, infant testing difficulties notwithstanding, the present standardized test data, when considered along with performance on learning tasks and language tests (see Figure 53) indicates an unquestionably superior present level of cognitive development on the part of the experimental group.

COMPARISON TO AN AVERAGE GROWTH FUNCTION
Figure 54

Age in Mos.	6	10	14	18	22	24	27	30	33	36	39	42	45	51
Experimental	7.1	11.5	17.2	21.2	26.9	29.6	35.4	41.3	45.8	49.0	52.2	56.0	59.6	62.8
Control	5.8	11.3	15.4	18.1	21.6	23.1	27.0	30.3	33.6	35.9	39.7	42.2	46.5	50.1



APPENDIX A

INTELLIGENCE AND SEVEN PHYSIOLOGICAL VARIABLES IN THE YOUNG CHILD, TWO TO FIVE YEARS OF AGE

The young child's physiological makeup will determine to a large extent his abilities to adapt and interact within his environment. Although much research has been performed on neonates and children, longitudinal studies concerning physiological and intellectual correlates have been scarce. Brackbill (1967) points to this vast literature on neonates and speculates that the paucity of research with young children could be due to the availability of neonates over young children 2-5 years of age, as well as the many problems associated with longitudinal research. There are, however, qualitative (intellectual-cognitive) differences as well as quantitative (physiological) differences occurring during this period of time which we have tried to consider.

Kagan (1963) explored the relationship between parents and offspring chest diameters and intellectual ability. Over 100 pairs of parents were then separated at the median into large and small chested groups. The results indicated that children of large chested parents had significantly higher IQ scores at 2, 3 and 3 1/2 years of age. These differences decreased with age with no differences evident at 10 years of age. There was no correlation between parents' IQ and chest size. In addition, the correlation between males' chest size at age 2 and IQ at age 3 was found to be significant. This did not hold for females. Kagan suggests that a large chest size may be an indication of precocious development.

Edwards (1968) tested 147 children on APGAR scales, one and five minutes after birth and presented various intellectual-cognitive tests four years later. The tests presented at 4 years of age were: Revised Stanford-Binet Form L-M, Graham-Ernhart Block Sort Test, Fine Motor Task, and Gross Motor Task. Results indicated that IQ at 4 years was most highly associated with respiratory effort at one minute and concept formation was most highly associated with respiratory effort at five minutes. Additionally, the magnitude of the correlation between physical condition at birth and later development was higher with fine and gross motor coordination than with intelligence and conceptual abilities. Motor measures were more predictive than IQ scores with APGAR scores.

It appears as Singer (1968) states that the degree to which cognitive abilities, motor abilities, and physical characteristics interrelate within a child has yet to be ascertained. Brace (1941), Ryan (1963), Ragsdale and Breckenfeld (1934), Start (1964) and Harmon and Oxendine (1961) all report low correlations between intelligence and physical performance. It may be that there is a lack of a relationship between physical and mental status, or that the relationship has yet to be determined.

The longitudinal evaluation of certain physical variables is, however, fraught with a seemingly endless host of difficult methodological problems.

Such factors as the time of day, the activities preceding measurement as well as events anticipated by the children introduce artifacts into their measurement, particularly as done by nonprofessional personnel. The previously mentioned problems probably affect heart rate and blood pressure the most. In addition, what is difficult even for professionals measuring these variables is complicated in this case by the lack of trained medical personnel. Our chief concern at this time is that, as a group, the children essentially be within the normal range.

This report presents the assessment of the physical and physiological status of the experimental and control groups of the Milwaukee Project. Seven physiological variables and their development were compared to various norms presented in Watson and Lowrey (1967). The variables are: height, weight, thoracic circumference, heart rate, systolic and diastolic blood pressure, cranium circumference and number of teeth. The measurements of the experimental and control children were made under circumstances which were not ideal. Both the children and the person making the measurements had just finished an hour long session of testing and free play and were looking forward to treats and relaxation. The children were typically very active and under the circumstances it was not always possible to make accurate measures. The diastolic and systolic blood pressure measures are particularly sensitive to such situational variables, and as has been pointed out, are fraught with difficulties in measurement that even well-trained personnel encounter. The inaccuracies hopefully are small.

The norms which are used for comparison are not necessarily applicable to the children in the study. Various studies have shown that race and socioeconomic status have an effect on the physical characteristics of children, although the differences are not always great. In the graphs, the norms used are for American males, with no consideration of race or socioeconomic status. The male norm is used because males develop more quickly during the first six years.

Across five of the seven variables -- height, weight, heart rate, systolic and diastolic blood pressure and cranium circumference -- development appears normal. The control children are somewhat larger in size as reflected in the height, weight, cranium circumference and thoracic circumference measures until about age 4, when the two groups converge. The differences are not large, however.

The remaining two variables -- number of teeth and thoracic circumference -- show some discrepancies with regard to normal development. The thorax measurements of both groups appear above average across all measured age periods. Significance of this difference has not been statistically assessed. The differences may reflect differences in measuring techniques as the deviations are not large.

Both groups exhibit subaverage development in number of erupted teeth from ages two to three years. The differences are most marked at ages 2 and 2 1/2 with the differences being erased by three years of age.

In general normal physiological development is seen in both groups as a function of the seven variables and the presented age ranges.

Height

Annual height increments continually diminish from birth to maturity with the exception of the adolescent growth spurt. Average birth length is 20 in. (50 cm.). At the end of the first year this length has increased by 50%. By the age of 4, birth length has doubled and by the thirteenth year the birth length has trebled.

Table 1

HEIGHT OF AMERICAN MALES AND FEMALES

Age (mos.)	Height Male (in.)	s.d. (in.)	Height Female (in.)	s.d. (in.)
24	34.4	1.1	33.9	1.3
30	36.3	1.3	35.9	1.3
36	38.0	1.3	37.9	1.4
42	39.4	1.4	39.2	1.5
48	40.9	1.5	40.7	1.5
54	42.2	1.5	42.2	1.7
60	43.6	1.6	43.5	1.7

The experimental children fall below the height norm for 2 year olds, but at all other age groups both the experimentals and controls are within the expected norms. See Figure 1. The use of the male norm does not explain the depressed average height of the experimentals at age 2, since the females in the experimental group are on the average taller than the males until after age 4.

Table 2

HEIGHT OF EXPERIMENTAL AND CONTROL CHILDREN

Age (mos.)	Experimental (in.)	Control (in.)
30	35.64	36.86
36	38.01	38.59
42	39.39	39.49
48	41.14	40.80
54	43.06	42.17
60	44.33	

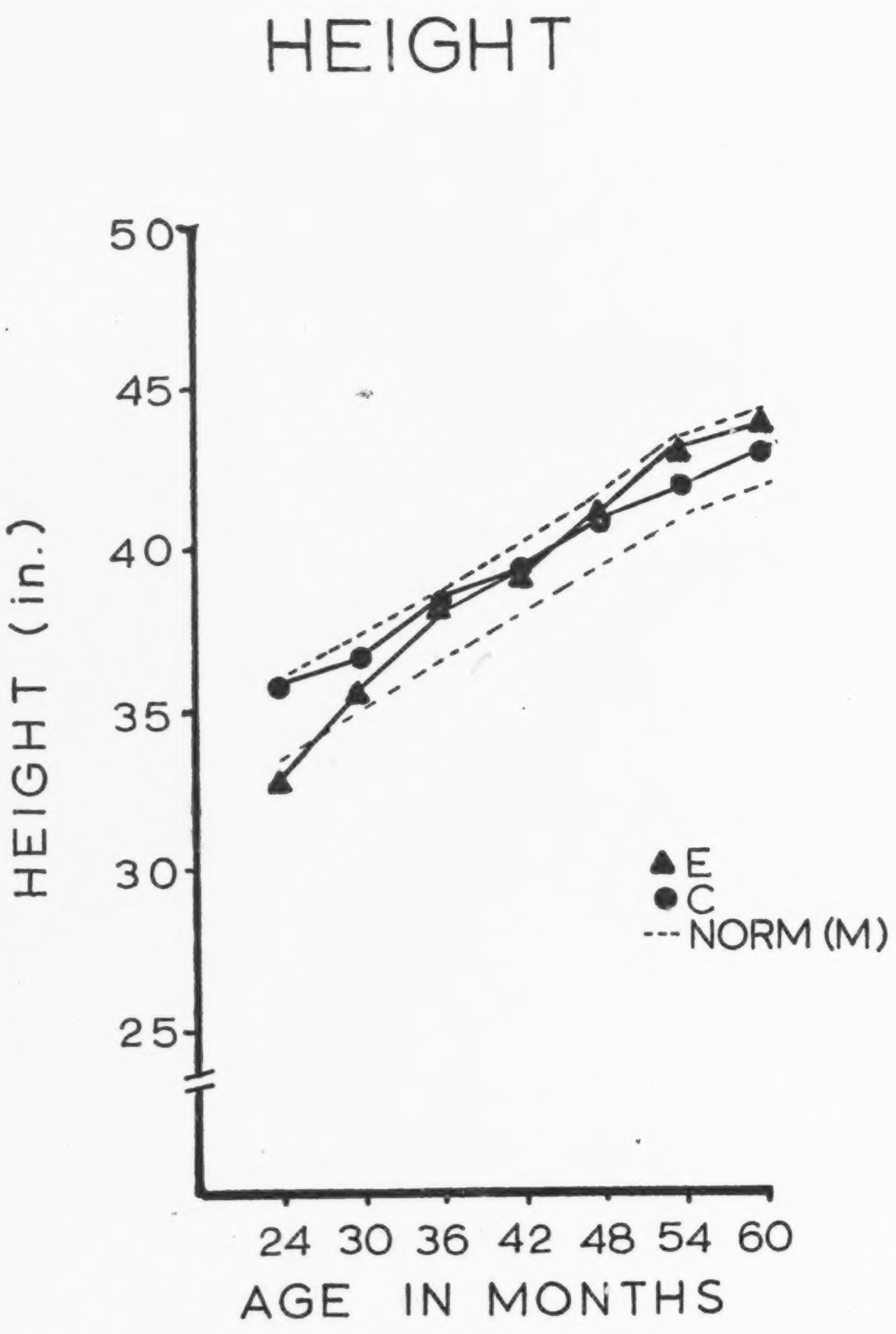


Figure 1

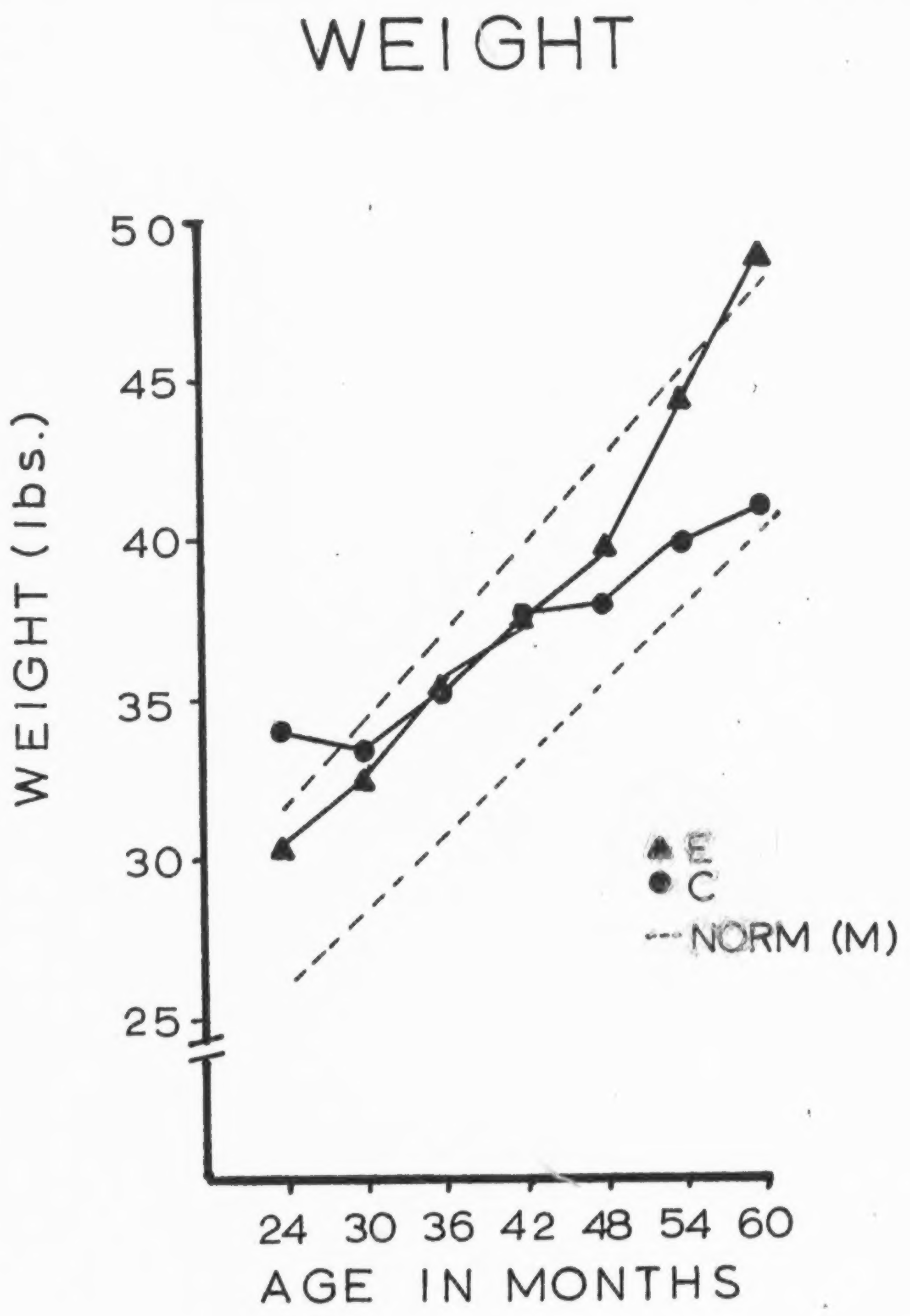


Figure 2

Weight

According to Watson & Lowrey (1967) weight is the best index of nutrition and growth as it sums up all the increments in general size. The mean birth weight is 7-7.5 lbs. with a 10% loss of birth weight in the first few days of life. This weight is usually regained by the 10th day of life. In the first 3 mos. of life the normal infant gains approximately 2 lbs./month. The birth weight is tripled by 12 months, and quadrupled by 24 months. After the age of 2, annual weight increments average 5 lbs. until the 10th year. After this rapid weight gain occurs during the adolescent growth spurt.

Table 3

WEIGHT OF AMERICAN MALES AND FEMALES

Age (mos.)	Weight Males (lbs.)	s.d. (lbs.)	Weight Females (lbs.)	s.d. (lbs.)
24	29.2	3.0	27.6	3.0
30	31.5	3.3	30.1	3.6
36	33.5	3.6	32.5	3.9
42	35.9	4.0	35.0	4.2
48	38.1	4.3	37.2	4.6
54	40.5	4.6	40.0	5.2
60	42.8	5.0	42.3	5.8

The Milwaukee Project children fall within the norm except at age 2, when the controls are slightly above the norm and at age 5, when the experimentals are slightly above the norm. See Figure 2.

Table 4

WEIGHT OF EXPERIMENTAL AND CONTROL CHILDREN

Age (mos.)	Experimental (lbs.)	Control (lbs.)
30	32.63	33.61
36	35.52	35.31
42	37.63	37.71
48	39.97	38.61
54	44.54	40.17
60	49.00	

Thorax

Table 5

AVERAGE CHEST CIRCUMFERENCE OF AMERICAN CHILDREN

Age (yrs.)	Circumference (cms.)
2	50
3	52
4	53
5	55

Both the experimentals and controls have larger than average thoracic cavities, with the controls being larger than the experimentals. See Figure 3. The growth trends for both groups tend to follow that for the norm, so the deviation of the groups may be a matter of measurement rather than actual greater size. This explanation, however, would not explain the apparently larger chest size of the control group.

Table 6

CHEST CIRCUMFERENCE OF EXPERIMENTAL AND CONTROL CHILDREN

Age (yrs.)	Experimental (cms.)	Control (cms.)
2	51.29	52.18
3	53.00	53.47
4	53.81	53.88
5	55.18	

Heart Rate and Blood Pressure

Fetal H.R. is usually between 130 and 160/min. There is essentially no difference between male and female Ss with females exhibiting slightly higher rates. In the newborn infant total blood volume ranges from 80-110 ml/kg during the first days of life. In the child this volume decreases to 75-90 ml/kg and in the adult 70-85 ml/kg. Total blood volume at birth averages 200 ml and in the average male and female adult we find 5500 ml and 4200 ml respectively. Systolic and diastolic pressure tend to rise with age.

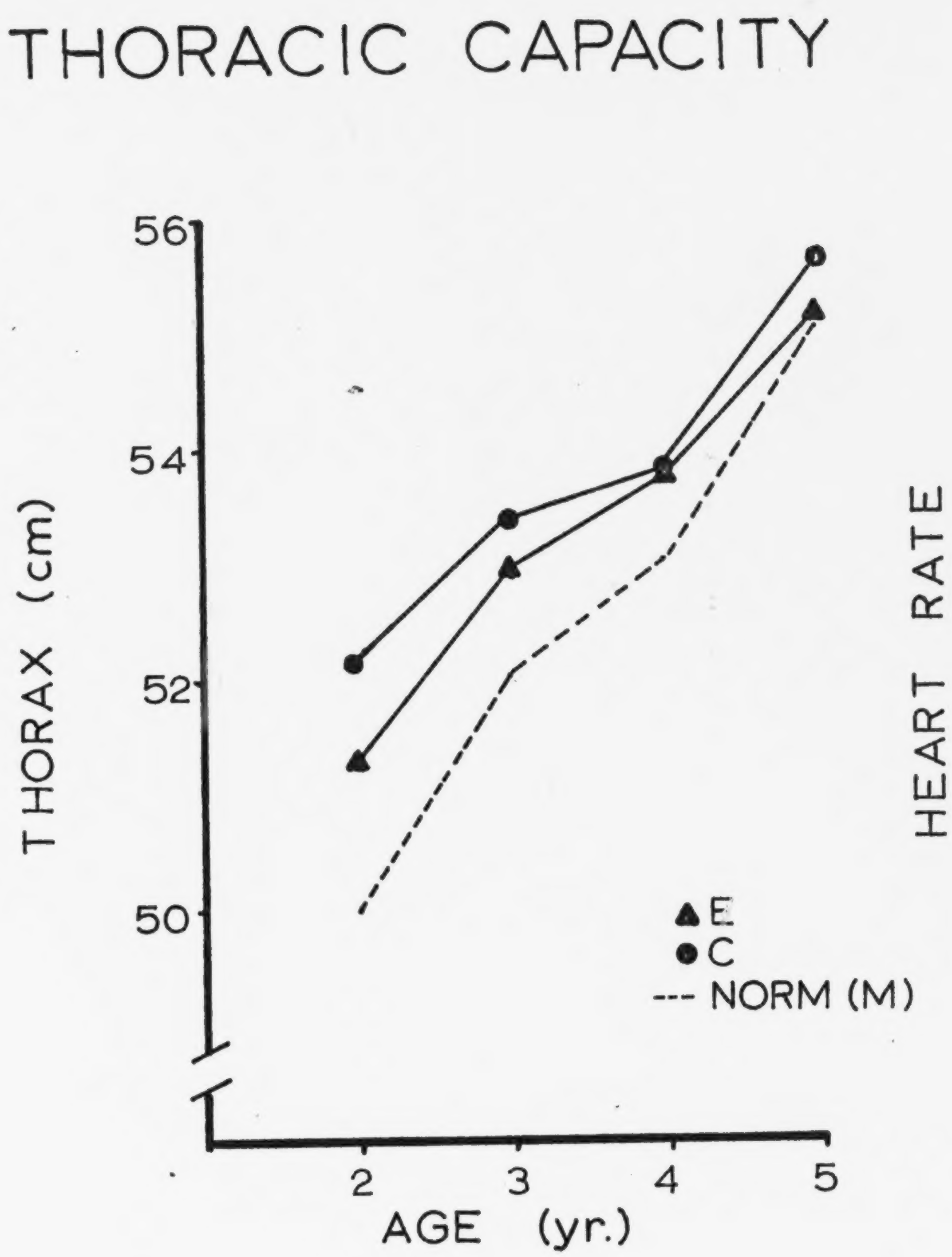


Figure 3

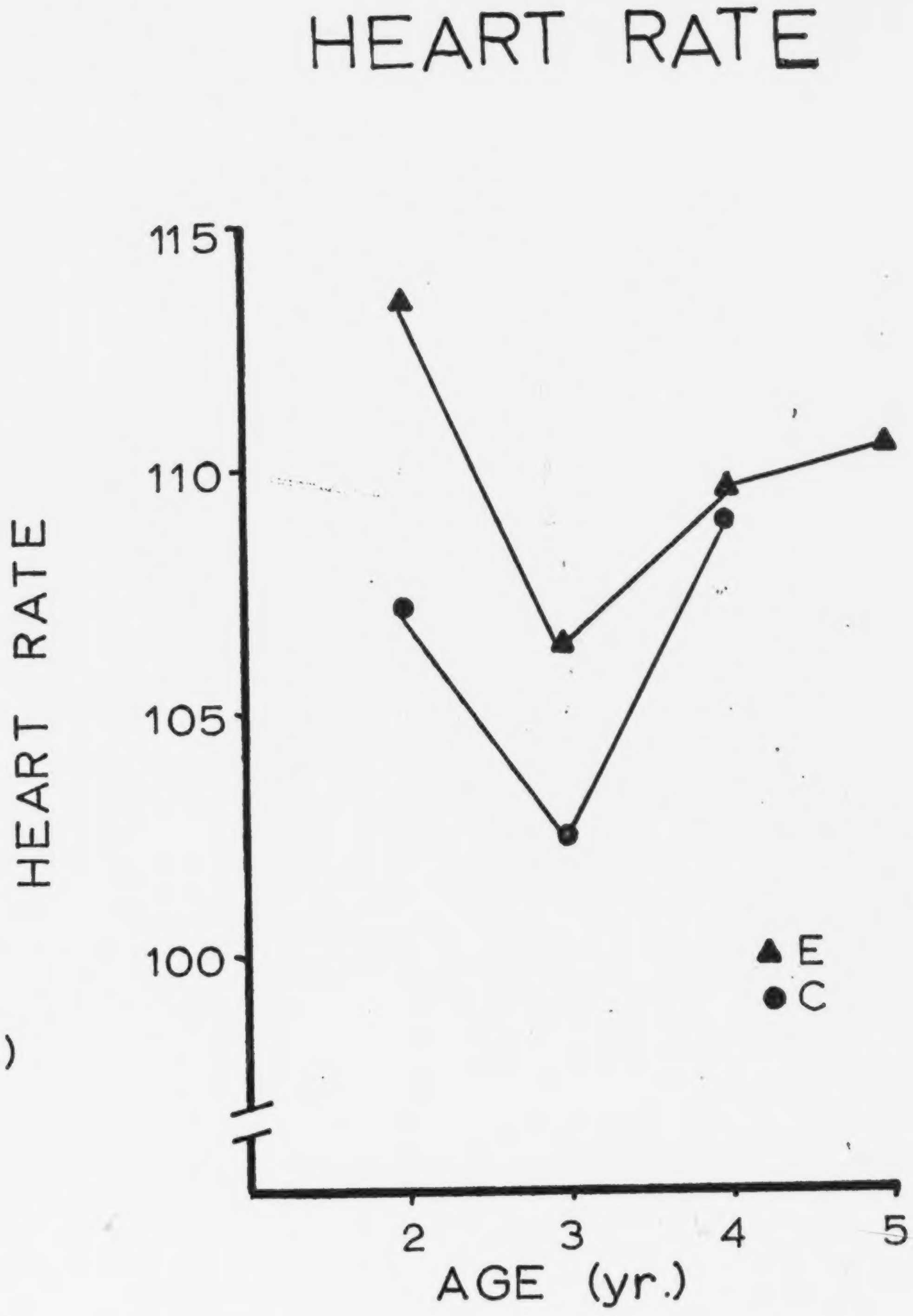


Figure 4

Table 7

AVERAGE H.R. FOR CHILDREN AND INFANTS

Age (mos.)	Average Rate	2 s.d.'s
12	115	40
24-48	105	35
72	95	30

Both groups of Milwaukee Project children have heart rates near the mean of the range of normal heart rates. See Figure 4. The controls have slightly slower heart rates until age 4, when they have almost the same rate as the experimentals.

Table 8

HEART RATE OF EXPERIMENTAL AND CONTROL CHILDREN

Age (yrs.)	Experimental	Control
2	113.64	107.27
3	106.24	102.47
4	109.81	109.13
5	110.09	

Table 9

NORMAL BLOOD PRESSURE (mm Hg.)

Age (mos.)	Systolic	2 s.d.	Diastolic	2 s.d.
24	99	25	65	25
48	99	20	65	20
72	100	15	60	10

The diastolic and systolic blood pressure of the two groups falls within the lower range of the norm. See Figure 5. It is suspected that this may be due to the manner in which the blood pressure is measured: if pressure on the arm band is released too quickly, a lower reading will be obtained. Differences between the experimentals and controls does not appear to be significant.

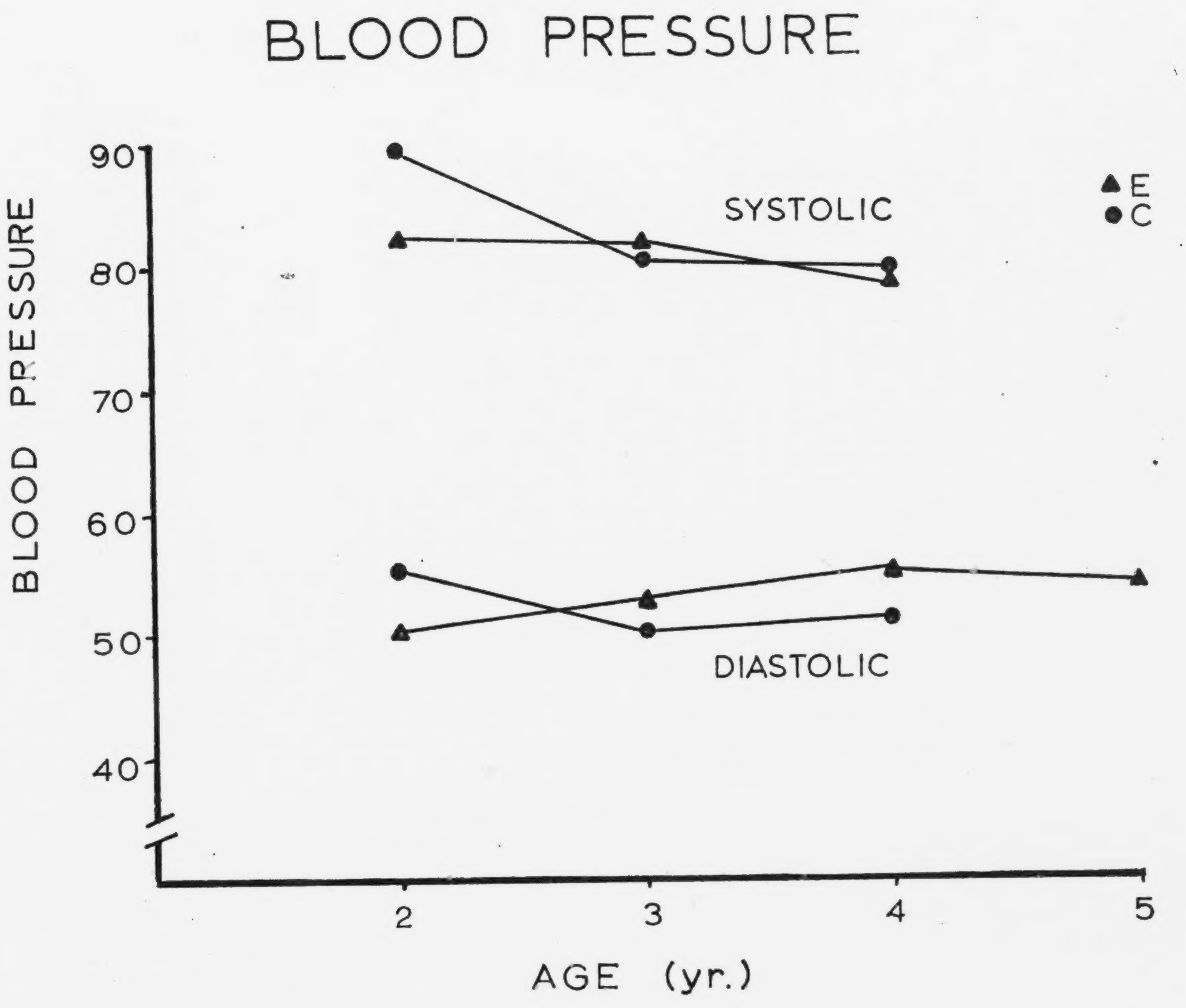

BLOOD PRESSURE
BLOOD PRESSURE
90
80
70
60
50
40
SYSTOLIC
DIASTOLIC
▲ E
● C
2
3
4
5
AGE (yr.)

Figure 5

Table 10

BLOOD PRESSURE OF EXPERIMENTAL AND CONTROL CHILDREN

Age (yrs.)	Experimental		Control	
	Systolic	Diastolic	Systolic	Diastolic
2	82.86	50.36	89.09	55.00
3	82.40	53.00	81.76	50.59
4	79.52	55.24	80.31	51.56
5	80.00	54.55		

Cranium

The importance of cranial measurement is that it permits a prediction of intracranial volume and rate of brain growth. Head circumference at birth averages 35 cm. Normal range is 1.2 cm. above or below that norm. During the first 4 months a 5 cm. increase is normal with another 5 cm. increase in the next 8 months. From the end of year 1 to the age of 20 only a 4 in. increase occurs in the circumference.

Table 11

AVERAGE HEAD CIRCUMFERENCE

Age (mos.)	Circumference (cm.)	s.d. (cm.)
24	49.0	1.2
36	50.0	1.2
48	50.5	1.2
60	50.8	1.4

Cranium size for the two groups again falls within the expected norms. See Figure 6. The controls are ahead of the experimentals until age 4, when the groups approach each other. The larger cranium size is consistent with the greater height and thoracic circumference of the controls.

Table 12

HEAD CIRCUMFERENCE OF EXPERIMENTAL AND CONTROL CHILDREN

Age (yrs.)	Experimental	Control
2	48.64	49.82
3	50.20	51.06
4	51.33	51.38
5	52.18	

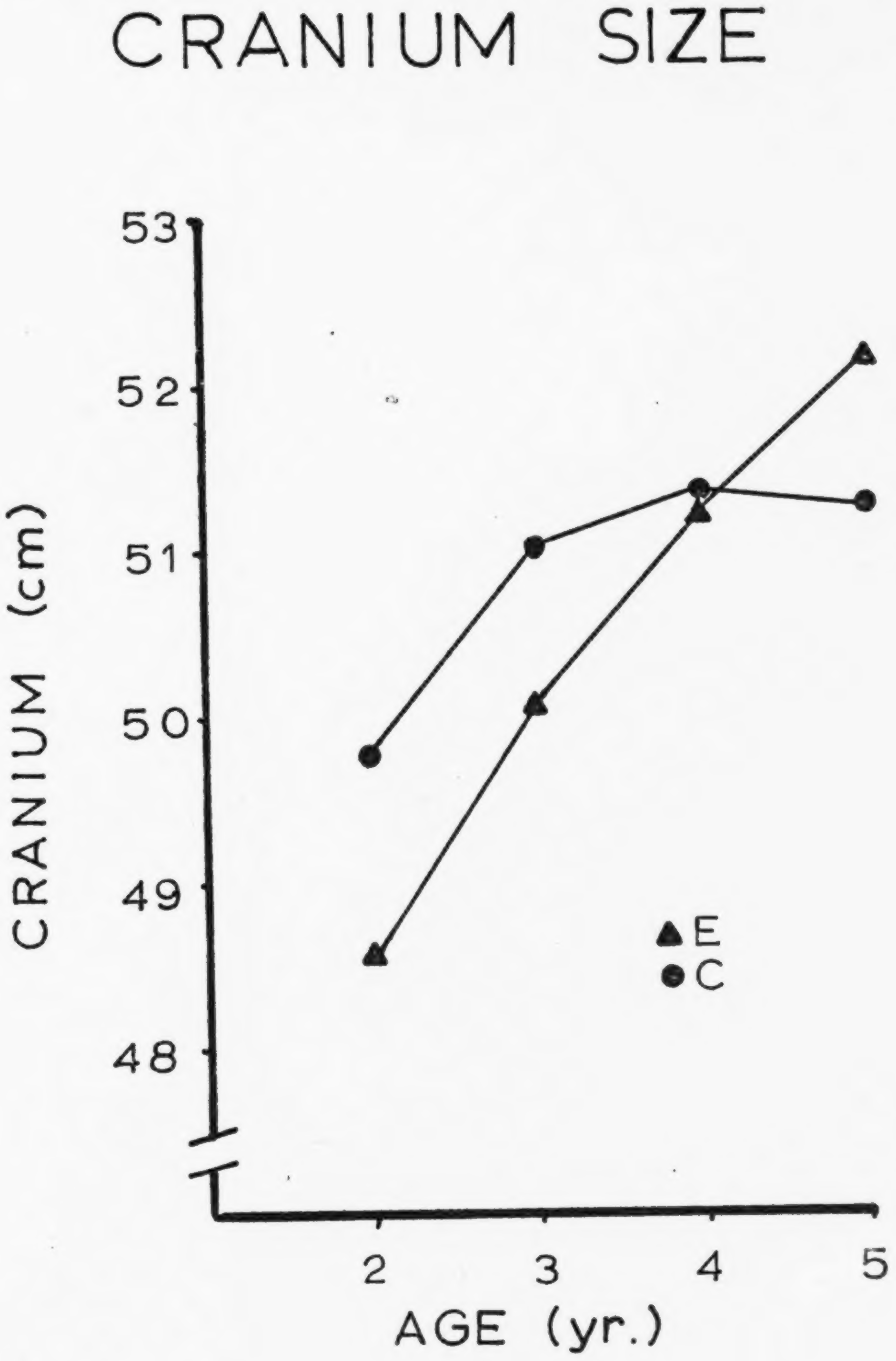


Figure 6

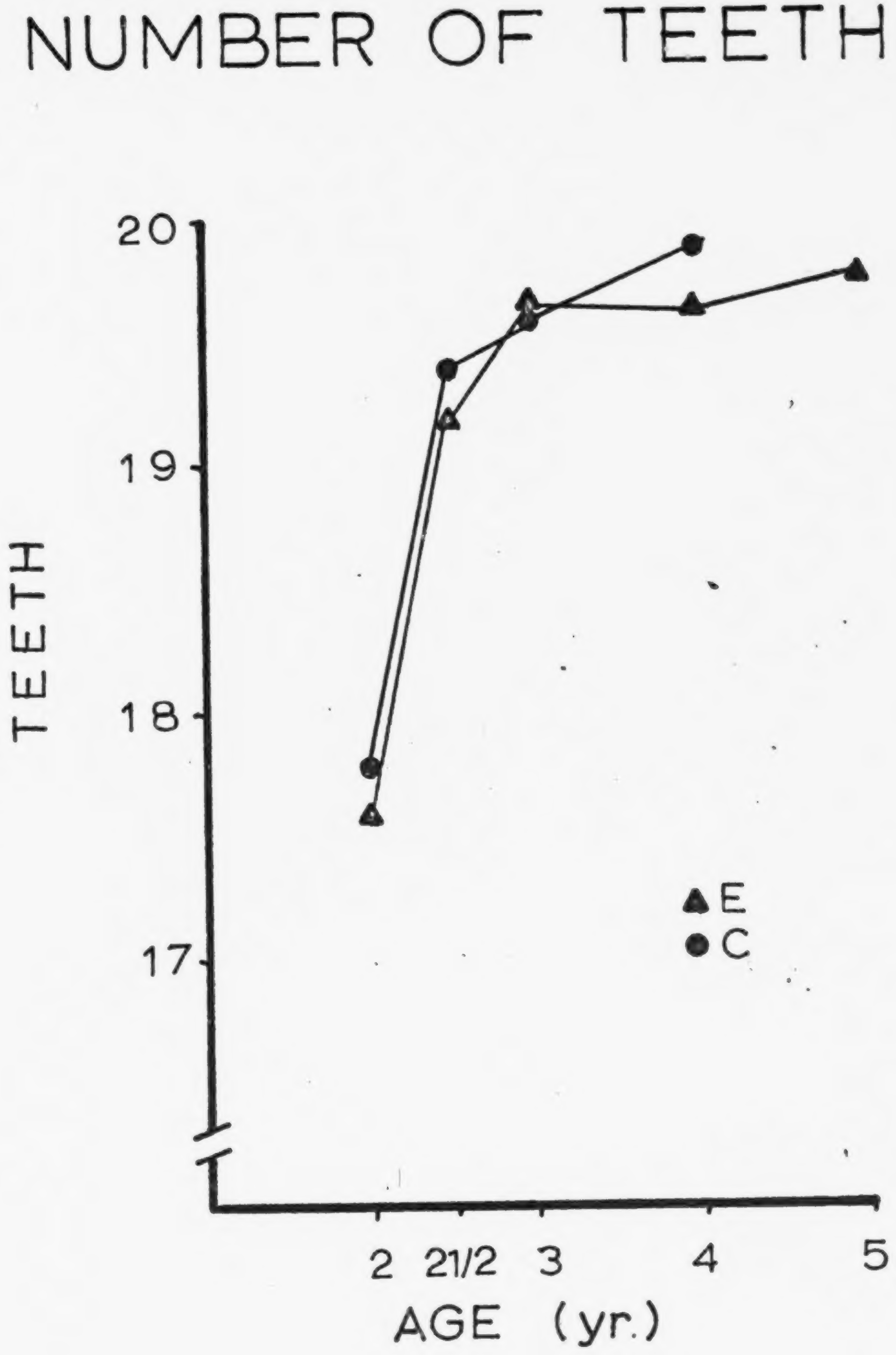


Figure 7

Teeth

There are six stages of tooth development:

1. growth
2. calcification and maturation
3. primary teeth eruption
4. resorption of roots of primary teeth
5. eruption of permanent teeth
6. attrition

There is a tendency for males to have teeth erupt sooner than females. Premature children have later eruption than full term Ss. Some investigators have found that the number of permanent teeth erupted does not have a high correlation to bone age calcification. Tooth age and eruption are not influenced by normal endocrine function. The most important aspect of tooth eruption is the order and site of permanent teeth eruption. Time of eruption is not a crucial variable.

Table 13

NORMAL TOOTH ERUPTION

Age (mos.)	Teeth
6-12	2 lower central incisors
6-12	2 upper central incisors
6-12	2 upper lateral incisors
12-15	2 lower lateral incisors
12-15	4 anterior molars
15-30	4 canines
15-30	4 posterior molars
60-84	4 first molars
78-96	4 central incisors

Both groups of children are somewhat behind the norm in the number of teeth, although they seem to have caught up by age three. See Figure 7. Again, the controls are ahead of the experimentals except at age 3.

Table 14

TOOTH ERUPTION OF EXPERIMENTAL AND CONTROL CHILDREN

Age (yrs.)	Experimental	Control
2	17.57	17.82
2.5	19.21	19.46
3	19.72	19.65
4	19.71	19.88
5	19.82	

BIBLIOGRAPHY

Abernathy, E.M. Relationships between mental and physical growth. Monogr. Soc. Res. Child Develpmt., 1936, No. 7.

Apgar, V. A proposal for a new method of evaluation of the newborn infant. Anesth. & Analg., 1953, 32, 260-267.

Babson, G., Kangas, J., Young, N., and Bramhall, J.L. Growth and development of twins of dissimilar size at birth. Pediatrics, 1964, 33, 327-333.

Bayley, N. The development of mother abilities during the first three years. Monogr. Soc. Res. Child Develpmt., 1935, No. 1.

Bridger, W.H., Birns, B.M., and Blank, M.M. A comparison of behavioral ratings and heart rate measurements in human neonates. Psychosomat. Med., 1965, 27, 123-134.

Drillien, C.M. A longitudinal study of the growth and development of prematurely and maturely born children. Part VII: Mental development 2-5 years. Arch. Dis. Child, 1961, 36, 233-244.

Drillien, C.M. A longitudinal study of the growth and development of prematurely and maturely born Children. Part III: Mental development. Arch. Dis. Child, 1959, 34, 37-45.

Edwards, N. The relationship between physical condition immediately after birth and mental and motor development at age four. Genet. Psych. Monogr., 1968, 78, 257-289.

Eppright, E.S., and Sidwell, V.S. Physical measurements of Iowa school children. J. Nutrition, 1954, 54, 543-556.

Garn, S.M., Clark, A., Landkof, L., and Newell, L. Parental body build and developmental progress of the offspring. Science, 1960, 132, 1555-1556.

Harper, P.A., Fischer, L.K., and Rider, R.V. Neurological and intellectual status of prematures at three to five years of age. J. Peatr., 1959, 55, 679-690.

Iowa Child Research Station: Physical traits of young children: Report of measurements on one hundred fifty boys and one hundred sixty-seven girls from 3-6 years of age. Amer. J. Dis. Child., 1929, 38, 541-546.

Ismail, A.H., and Gruber, J.J. The predictive power of coordination and balance items in estimating intellectual achievement. National Coll. Phys. Educ. Assn. for Men, 69th proceedings, 1966, 69, 89-91.

Kagan, J. and Garn, Stanley M. A constitutional correlate of early intellective functioning. J. Genet. Psych., 1963, 102, 83-89.

Kagan, J., and Moss, H.A. Parental correlates of child's IQ and height: A cross validation of the Berkeley Growth Study results. Child Develpmt., 1959, 30, 325-332.

Knobloch, H., Rider, R.V., Harper, P., and Pasamanick, B. Neuropsychiatric sequelae of prematurity. J. Amer. Med. Assn., 1956, 161, 581-585.

Kulcinski, L.E. The relation of intelligence to the learning of fundamental muscular skills. Res. Quart., 1945, 16, 266-276.

Lucas, W.P. and Pryor, H.B. Range and standard deviations of certain physical measurements in healthy children. J. Pediatrics, 1935, 6, 533-545.

Meredith, H.V., and Knott, V.B. Changes in body proportions during infancy and the preschool years: I. The thoracic Index. Child Dev., 1937, 8, No. 2.

Meredith, H.V., and Knott, V.B. Changes in body proportions during infancy and the preschool years: III. The skelic Index. Child Dev., 1938, 9, No. 1.

Meredith, H.V. The rhythm of physical growth: A study of 18 anthropometric measurements on Iowa City white males ranging in ages between birth and eighteen years. Univ. Iowa Stud., Stud. in Child Welfare, 1935, 11, No. 3, 128.

Singer, Robert N. Interrelationship of physical, perceptual-motor, and academic achievement variables in elementary school children. Percept. Mot. Skills, 1968, 27, 1323-1332.

Singer, R.N., and Brunk, J.W. The relationship of perceptual-motor ability to intellectual ability in elementary school children. Percept. Mot. Skills, 1967, 24, 967-970.

Weisman, S.A. Contour of the chest in children: II. According to weight and height. Amer. J. Dis. Child, 1935, 49, 47-51.

Books

Bayer, L.M., and Bayley, N. Growth diagnosis. Chicago: University of Chicago Press, 1959.

Blake, F.G., Wright, F.H., and Waechter, E.H. Nursing care of children. Philadelphia: J.B. Lippincott Co., 1970.

Brackbill, Yvonne. Infancy and early childhood. New York: The Free Press, 1967.

Cheek, D.B. Human Growth: Body composition, cell growth, energy, and intelligence. Philadelphia: Lea & Febiger, 1968.

Drillien, C.M. The growth and development of the prematurely born infant. Baltimore: The Williams and Wilkins Co., 1964.

Jeans, P.C., Wright, F.H., and Blake, F.B. Essentials of pediatrics. Philadelphia: J.B. Lippincott Co., 1958.

Watson, E.H., and Lowrey, G.H. Growth and development of children. Chicago: Year Book Medical Publishers, Inc., 1967.

APPENDIX B

WISCONSIN LEARNING RESEARCH MACHINE

A continuous concern of researchers investigating human learning has been control of the experimental situation. Such control is desirable not only within one's own laboratory for obvious reasons, but between laboratories so that comparisons may be made of the results obtained from similar paradigms. In effect, the results of major research efforts often suffer because of subtle differences in manipulanda, discriminanda, and presentation format. Although a general problem in certain types of learning research with adults, the difficulties of control are all the more critical with the decreasing age level of the subject population. Children's tendencies toward distraction or tendency to respond to stimuli other than the central task relevant stimuli represent a major problem to child learning research.

In an effort to control this major problem of methodology as well as to have considerable flexibility in the choice of paradigms and choice of stimulus material, an apparatus was designed and built at the University of Wisconsin. The apparatus has been called the Wisconsin Learning Research Machine (WLRM). This instrument can be used in discrimination and concept learning research and in programmed teaching curricula. It offers four reinforcement modes and three controllable time parameters associated with the research paradigm. Stimulus presentation is by means of one or two Carousel Projectors which back project a prepared slide program (discriminanda). The response system utilizes either two, three, or four choice interchangeable button panels (manipulanda). An automatic recording is made of all stimulus presentations and responses, including reaction time. The system can permit delays at any point in the stimulus presentation, response consequence and/or reinforcement phase. This then is an overview of a general purpose programmable learning research device that provides considerable intra- and inter-experiment and experimenter control, both within and between laboratories.

Basically the machine was designed to be so flexible that nearly all visually displayed learning research paradigms could be implemented with a single apparatus, and to record automatically all pertinent information concerning the subject's responses. Furthermore, we desired a machine that could perform in elaborate paradigms with relatively unsophisticated research personnel. All preparation of the stimulus program could be done either in the laboratory before the equipment was moved or even at the test site by a simple selection of switches.

The apparatus consists essentially of two major components (These units are interconnected with a 20' cable): (1) the Display Unit (Figure 1) and (2) the Readout-Control Unit (Figure 2).

1. The display unit contains two slide projectors, the viewing screen, a response panel, and four types of reinforcement mechanisms: a

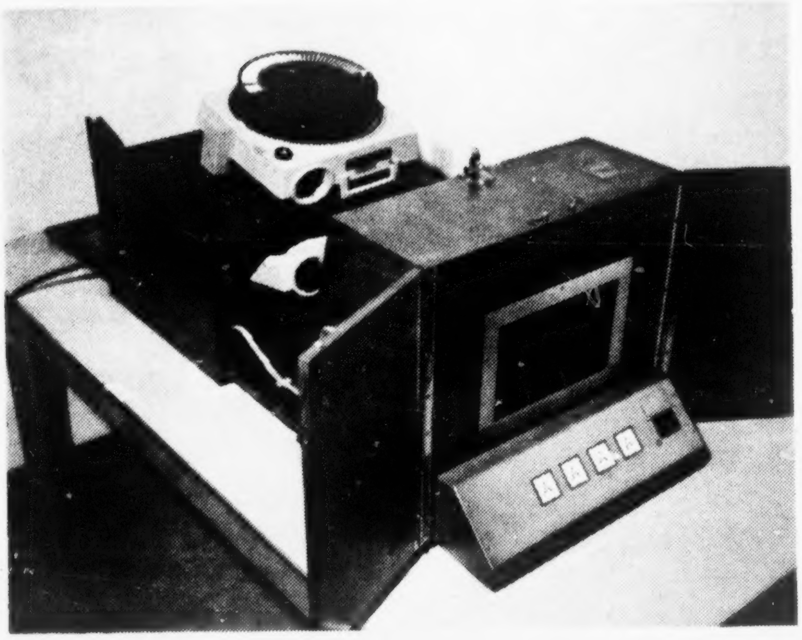


Figure 1

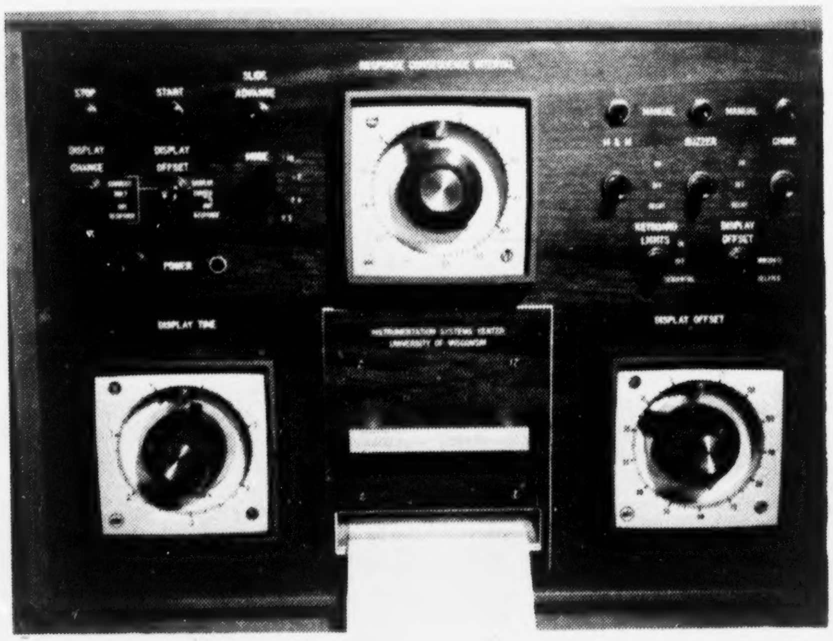

STOP
START
SLIDE ADVANCE
DISPLAY CHANGE
DISPLAY OFFSET
MODE
POWER
RESPONSE CONSEQUENCE INTERVAL
MANUAL
MANUAL
M & M
BUZZER
CHIME
KEYBOARD LIGHTS
DISPLAY OFFSET
DISPLAY TIME
INSTRUMENTATION SYSTEMS CENTER
UNIVERSITY OF WISCONSIN
DISPLAY OFFSET

Figure 2

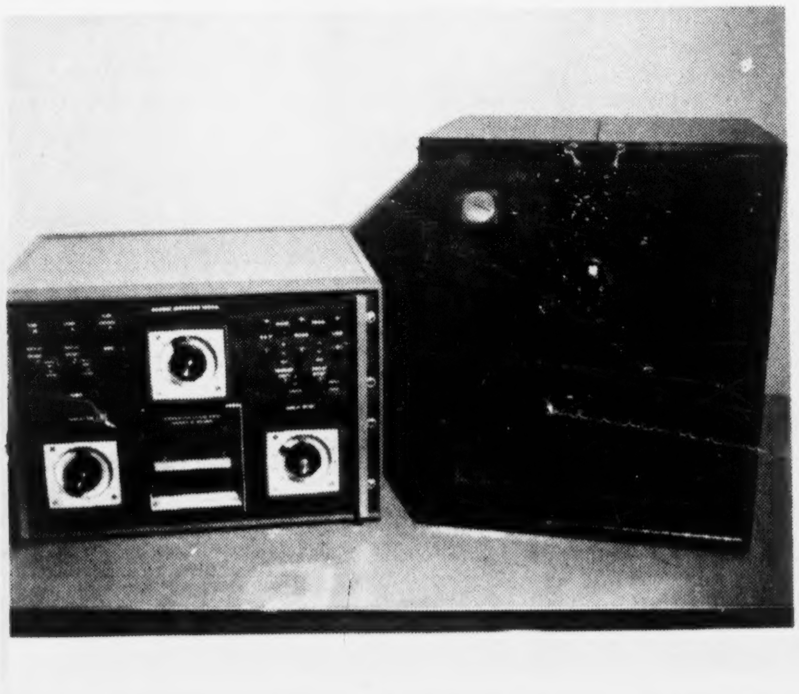


Figure 3

buzzer, a chime, an M&M candy dispenser, and lights in the response panel buttons.

The slide projectors are modified Kodak Ektagraphic Model E projectors with Ektanar 3 inch f/3.5 lenses. A solenoid has been added to each projector to provide display offset by shutter control.

The viewing screen is a Kodak black glass screen which provides a clear image to the subject with minimum glare. Four photocells are located below the screen. Light from holes punched in the slide frame falls on these cells to provide the coding information for desired response to the Readout-Control unit.

The interchangeable response panels plug into the display unit directly below the viewing screen. The researcher has the option of using a 2-choice, 3-choice, or 4-choice response panel. The response buttons are translucent plastic rectangles which can be lighted in certain program modes when the button is depressed.

At the option of the researcher the display unit can be used to provide positive reinforcement in the form of M&M's dispensed into a receptacle on the subject's response panel and/or a tone from a chime. Negative reinforcement can be provided by a buzzer. Lights in the response buttons can be used either as positive or negative reinforcement depending on the mode in which they are used (i.e., knowledge of results feedback).

The display unit is constructed of stained birch plywood. It has been designed so that the unit can be folded for storage or transportation into a compact size, with dimensions of 17" x 15 1/4" x 20 1/2" (See Figure 3). When in use the unit opens to a length of 34 1/2".

2. The Readout-Control unit contains the printer for recording response data, the electronics for controlling the WLRM, and the switches and timers used in programming the machine for any given paradigms.

The printer contains eleven modules which function as storage registers for the digital input information in addition to providing the impressions on the tape. The following data is recoded on the printer at the end of each trial.

1. Subject response(actual)
2. Desired response(correct)
3. Slide number for each projector
4. Projector displayed
5. Response time

Relay logic is used throughout the Readout-Control unit because of the flexibility required in the system and the need to interface with numerous electro-mechanical devices. Silicon Controlled Rectifiers are used to control many of the logic relays to reduce system complexity and increase the speed of operation. Motorola High Threshhold Logic modules are used in the clock which provides the signals which drive the printer and synchronize the logic relays.

Each time the subject responds, the data relating to that trial is recorded by the printer and the maximum display time is reset. The subject's response is compared with the slide code in a gating network. The output (correct or incorrect response) from the gating network controls the reinforcement mechanisms and the display offset and/or change in a variety of ways which are programmed by the researcher (refer to WLRM block diagram, Figure 4). The control unit contains three timing clocks, one of them being the maximum display time of the stimulus (discriminanda). This clock is a six second to six minute timer. It is used only in 3 modes (2A, 1P, and 1PD) of the four operations systems. Clock number two is a one second to one minute timer. It controls the time length that occurs between a response given by a subject and the consequence of that response. This clock is used in only the 1PD mode. The third clock is a two second to two minute timer. It is used only in the 1PD mode where it determines the length of display offset time, i.e., once the display is off, how long before the next can be presented.

There are four basic modes of operation of the LRM. They are:

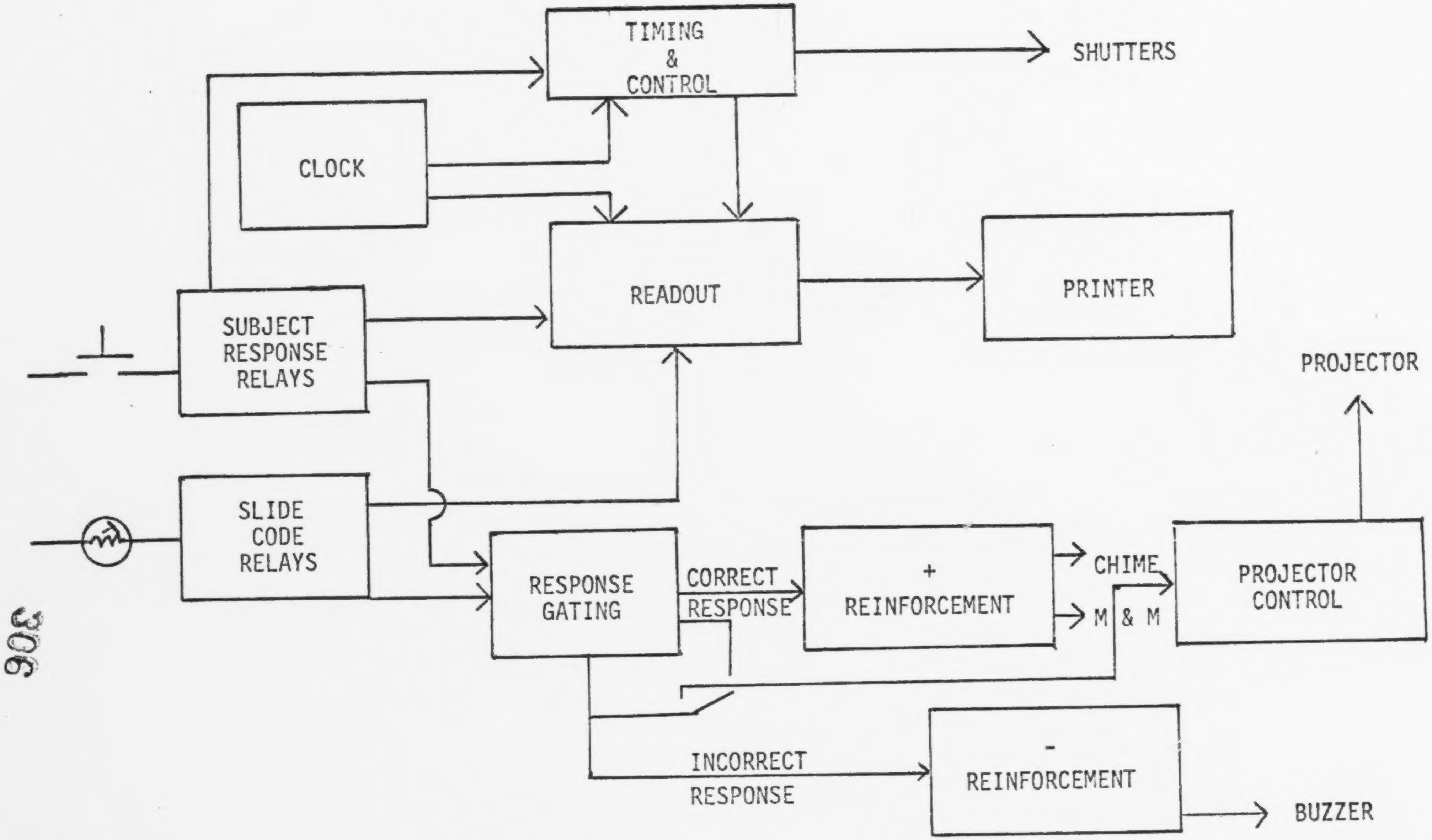
1) One Projector Delayed Mode	(1PD)	See Fig. 5
2) One Projector Mode	(1P)	See Fig. 6
3) Two Projector Alternate Mode	(2A)	See Fig. 7
4) Two Projector Simultaneous Mode	(2S)	See Fig. 8

In each one of these modes the researcher can elect a variety of operations appropriate to a particular experimental design.

The 1PD mode is the most versatile mode of operation. In this mode one projector is used for display and two timers are used for control of delay. The projector is activated by a signal relayed to it through the readout control unit. This signal can be immediate or at the operator's wish it can be delayed from two seconds to two minutes by the display offset timer.

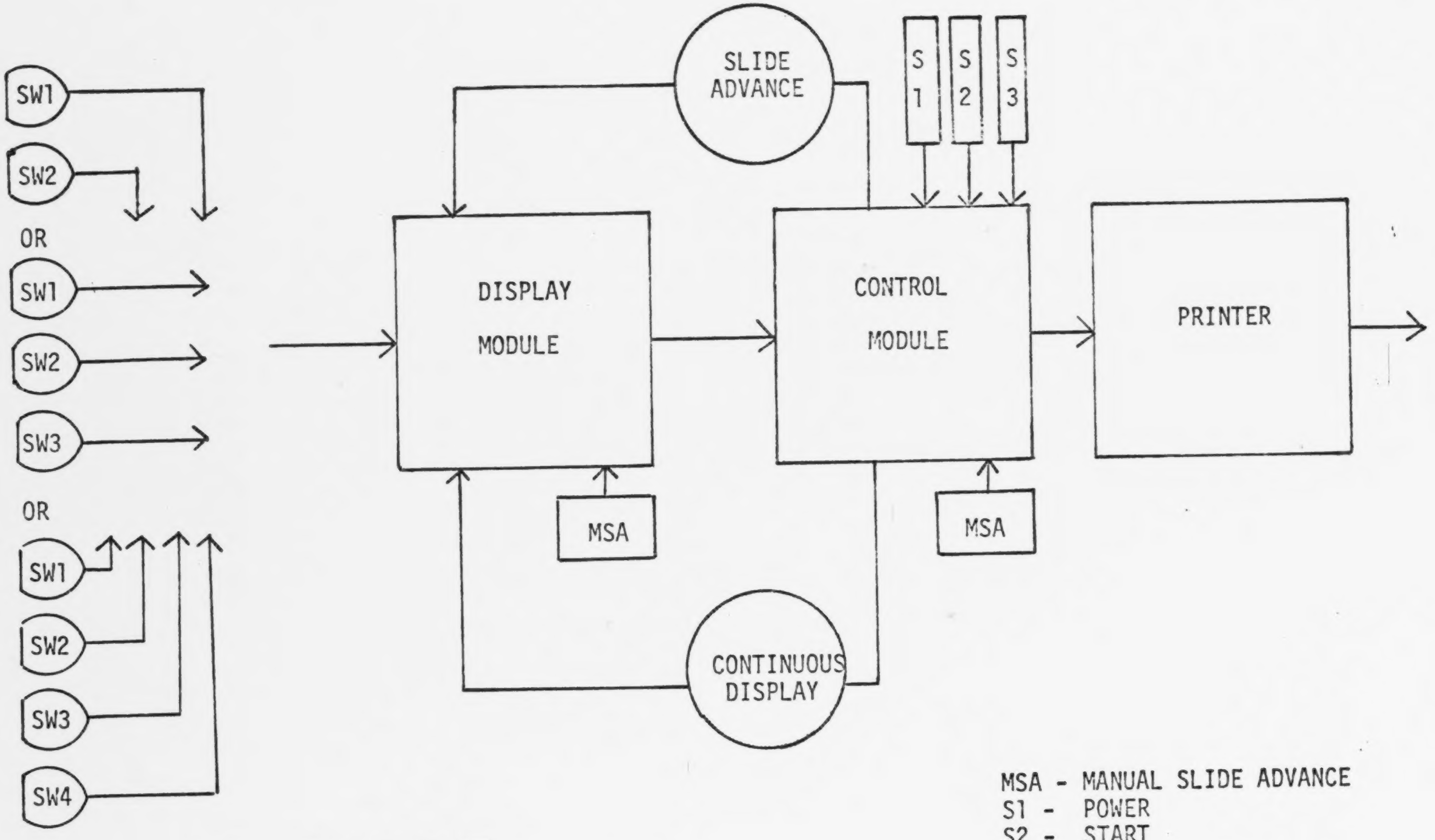
The operator may elect several options. By setting the display change switch to the proper position he may cause the slide to be advanced for any response or for only the correct response. In this mode the display offset circuits are also activated. They determine whether the screen is to be darkened for any response or only for a display change. After a response the time between the choice and the consequence is determined by the one second to one minute timer called the Response consequence Interval.

The subject can be given a two, three, or four choice availability. When a response is made, a signal is returned to the control unit where it is compared with a coded signal from the slide. The response signal


TIMING
&
CONTROL
SHUTTERS
CLOCK
READOUT
PRINTER
SUBJECT
RESPONSE
RELAYS
PROJECTOR
SLIDE
CODE
RELAYS
RESPONSE
GATING
CORRECT
RESPONSE
+
REINFORCEMENT
CHIME
M & M
PROJECTOR
CONTROL
INCORRECT
RESPONSE
-
REINFORCEMENT
BUZZER

WLRM BLOCK DIAGRAM

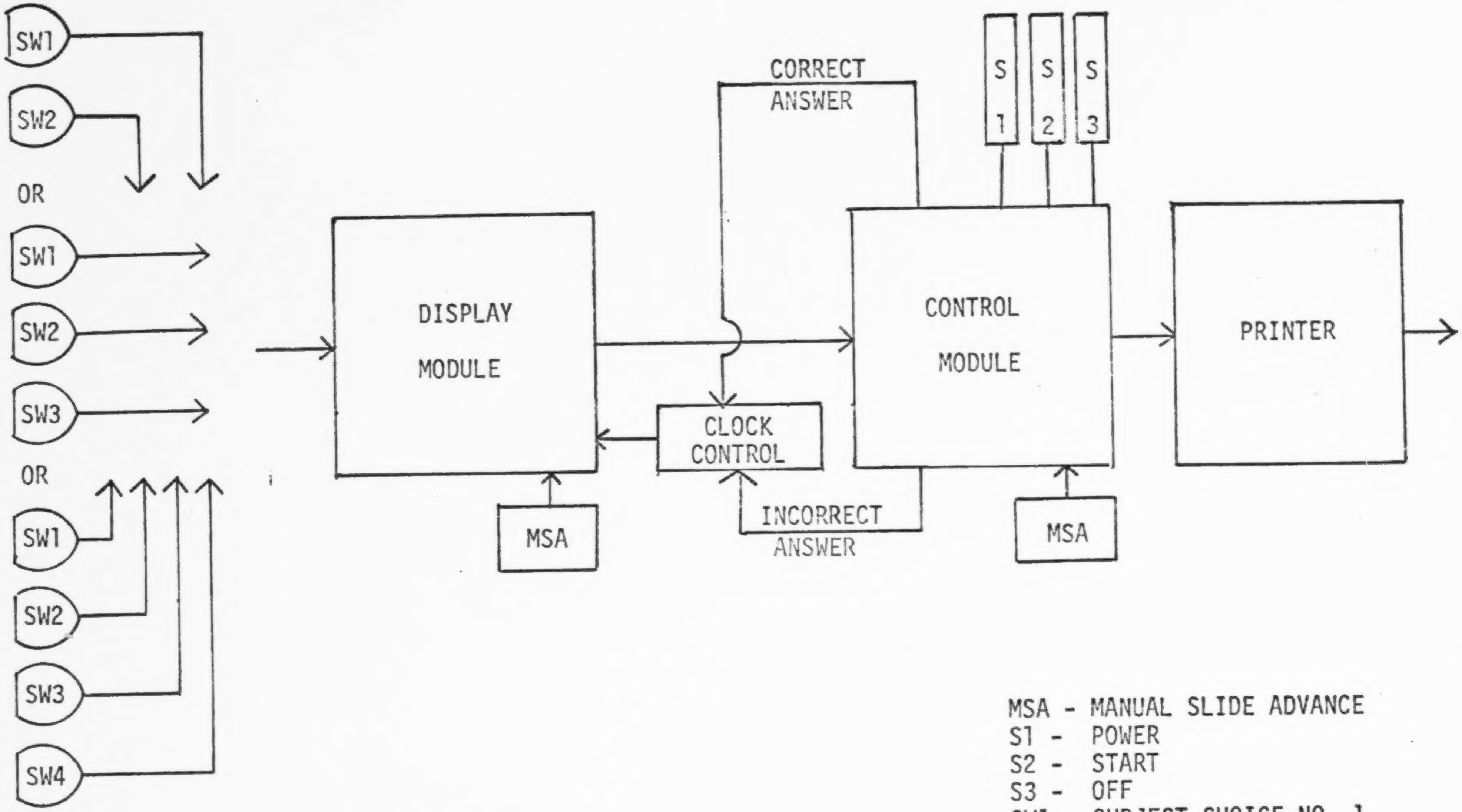
FIG. 4


SW1
SW2
OR
SW1
SW2
SW3
OR
SW1
SW2
SW3
SW4
SLIDE ADVANCE
S 1
S 2
S 3
DISPLAY MODULE
CONTROL MODULE
PRINTER
MSA
MSA
CONTINUOUS DISPLAY

1P MODE

MSA - MANUAL SLIDE ADVANCE
S1 - POWER
S2 - START
S3 - OFF
SW1 - SUBJECT CHOICE NO. 1
SW2 - SUBJECT CHOICE NO. 2
SW3 - SUBJECT CHOICE NO. 3
SW4 - SUBJECT CHOICE NO. 4

FIG. 5


SW1
SW2
OR
SW1
SW2
SW3
OR
SW1
SW2
SW3
SW4
DISPLAY MODULE
MSA
CLOCK CONTROL
CORRECT ANSWER
INCORRECT ANSWER
S 1
S 2
S 3
CONTROL MODULE
MSA
PRINTER

2A MODE

MSA - MANUAL SLIDE ADVANCE
S1 - POWER
S2 - START
S3 - OFF
SW1 - SUBJECT CHOICE NO. 1
SW2 - SUBJECT CHOICE NO. 2
SW3 - SUBJECT CHOICE NO. 3
SW4 - SUBJECT CHOICE NO. 4

FIG. 6

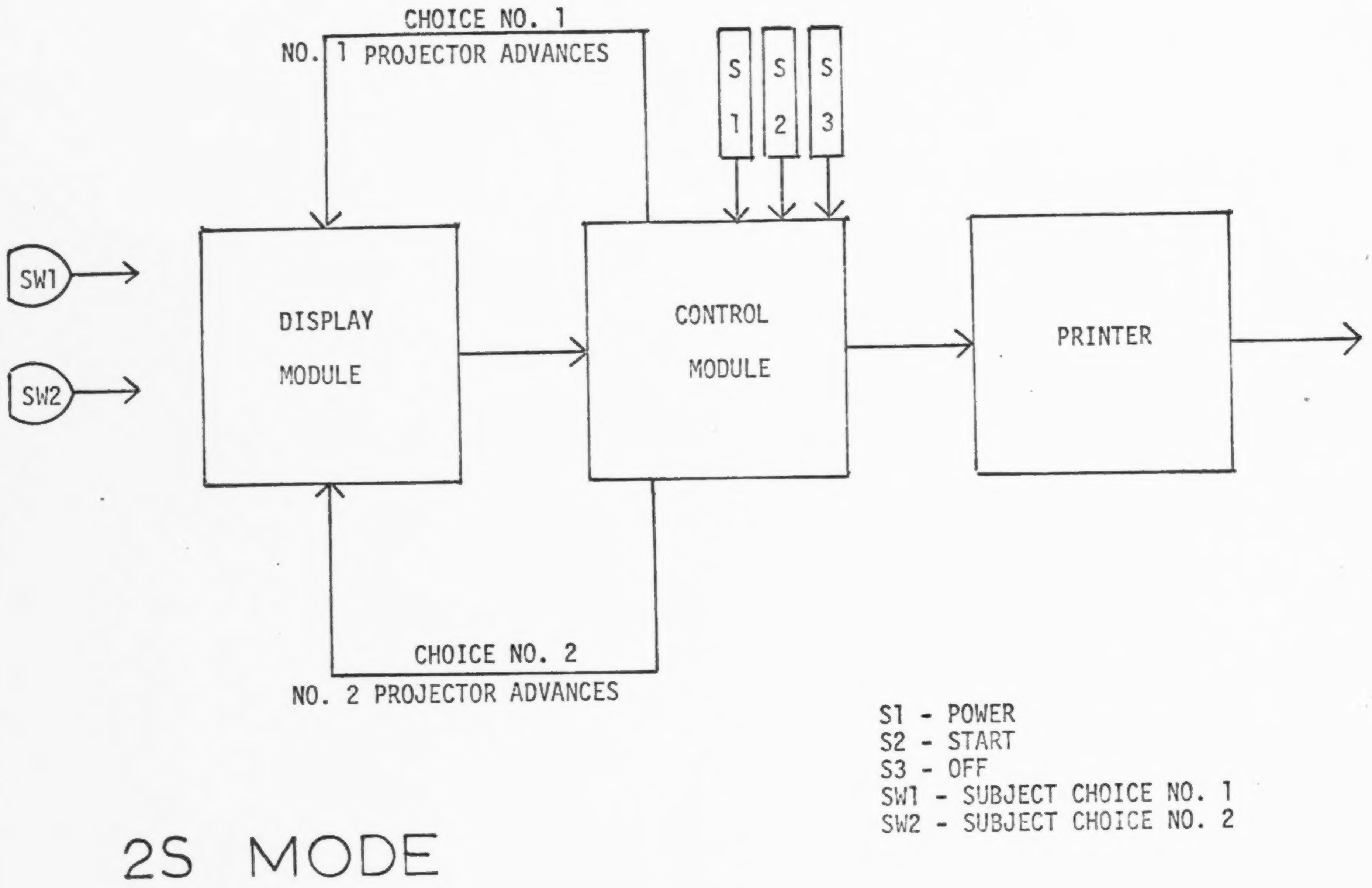
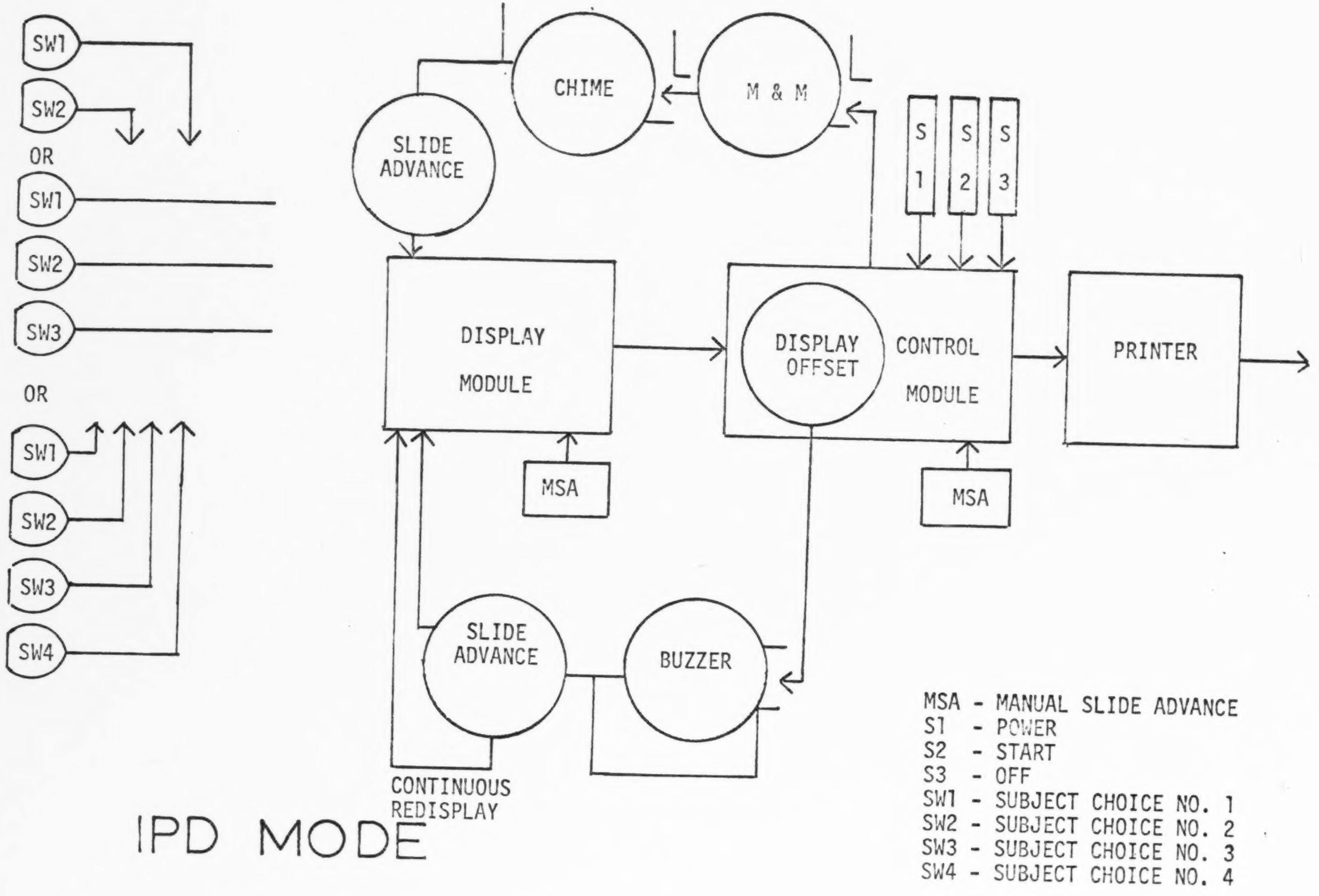

CHOICE NO. 1
NO. 1 PROJECTOR ADVANCES
S 1
S 2
S 3
SW1
SW2
DISPLAY MODULE
CONTROL MODULE
PRINTER
CHOICE NO. 2
NO. 2 PROJECTOR ADVANCES
S1 - POWER
S2 - START
S3 - OFF
SW1 - SUBJECT CHOICE NO. 1
SW2 - SUBJECT CHOICE NO. 2
2S MODE

FIG. 7


SW1
SW2
OR
SW1
SW2
SW3
OR
SW1
SW2
SW3
SW4
SLIDE ADVANCE
CHIME
M & M
S 1
S 2
S 3
DISPLAY MODULE
MSA
DISPLAY OFFSET
CONTROL MODULE
MSA
PRINTER
SLIDE ADVANCE
BUZZER
CONTINUOUS REDISPLAY

IPD MODE

MSA - MANUAL SLIDE ADVANCE
S1 - POWER
S2 - START
S3 - OFF
SW1 - SUBJECT CHOICE NO. 1
SW2 - SUBJECT CHOICE NO. 2
SW3 - SUBJECT CHOICE NO. 3
SW4 - SUBJECT CHOICE NO. 4

FIG. 8

is relayed to circuitry which controls lights in the response panel and to the reinforcement mechanisms. The response panel lights may be programmed to remain on or off all the time or to turn on for an incorrect response and remain on until a correct response is made.

The reinforcement units, an M&M candy dispenser, a set of chimes for positive reinforcement, and a buzzer for negative reinforcement can be operated independently or all together. Their operation may be immediate, delayed or not at all.

The 1P Mode is basically the same as the 1PD Mode except that there are fewer options. The display offset is set automatically at one second. For an incorrect response the display can be either offset or continuous. The final major difference is that none of the reinforcement options may be used, i.e., for use in paradigms where there are no correct or incorrect choices.

In the 2A Mode two projectors are used alternately to supply the display. The display offset time is almost instantaneous and the reinforcement mechanisms disconnected. Except for these properties, operation is the same as in the 1PD Mode.

The 2S Mode uses two projectors that simultaneously display half slides on their respective halves of the screen. In this mode a two button response panel is used. If switch one is depressed, a signal is relayed through the control unit to the printer and back to projector number one. If switch two is depressed, the printer records that fact but now projector number two is advanced. This ability to change the display on half of the screen without changing the other half allows the researcher to set up a preference testing situation.

Program capacity: each slide tray can carry upwards of 80 or 140 slides each. If necessary slide trays may be changed swiftly. In most cases the slide program merely continues until the subject has performed appropriately for the E.

Stimulus Programs:

There are, at this time, already available several complete stimulus program sets. These include:

1. Color-form matching:

Three geometric forms (circle, square, triangle), each in four colors (red, green, blue, yellow) are ordered according to modified Gellerman series (Fellows, 1967). The order controls for position, color or form as the standard. Subjects' task is merely to select one of two stimuli which he feels matches a standard in color or form. There is no right or wrong. The 1P mode is used.

2. Probability matching:

Two squares in two colors are randomized according to a modified Gellerman (Fellows, 1967), which controls for position. Each stimulus is under a different ratio of reinforcement which is randomly administered for a correct response. In this series any percentage of reinforcement may be chosen for each stimulus simply by coding an individual slide. Reinforcement may be immediate or delayed and either candy, chime, or lighted response. The 1PD mode is used.

3. Oddity discrimination:

Thirteen concept categories are employed in a 78 slide sequence. The thirteenth category is a functional category wherein the subject selects the item whose function does not fit. The remaining categories are divided into four major categories of color relevance, form relevance, size relevance and number relevance. Each relevant dimension is displayed an equal number of times as relevant with each of the other dimensions as irrelevant. Categories are randomly presented and position of the odd item is randomized. This is a 3 choice task using the 3 choice response panel and the oPD mode. Selection of reinforcements is available.

4. Intra-dimensional (ID) vs. extradimensional discrimination (ED) learning task:

An ID-ED discrimination learning task includes two sets of bivalved stimuli, prepared so that slides are present in a randomized sequence according to a modified Gellerman (Fellows, 1967). The stimulus values are vaiable both within and between. E can either set number of trials for pretraining task or allow performance to a criterion. Slide trays are readily interchangeable. This program uses the 1PD mode.

Future Modifications:

As the WLRM stands it has the potential for having several additional systems coupled or included with it: a) Readily coupled with any stimulus program is an audio program through a programmed tape recorder. Each response keys the recorder. This program is designed for use with teaching programs; b) Fading procedure may be implemented. Two stimuli are displayed simultaneously in overlapping fashion. One stimulus is then faded with successive responses; c) Intensive response properties can be measured and manipulated by the use of strain gauges in the response buttons.

Effort (amplitude) of the response and duration can also be automatically recorded. Use of a 'pick-off' unit could provide for tasks requiring control of the effortfulness of the response.

Such modifications are suggested to underscore the flexibility of this apparatus. It's main advantages are the tremendous flexibility of programming parameter controls and stimulus program accessibility. At this time we have only begun to develop programs for use in the WLRM. In addition we hope to provide stimulus programs for both research designs and teaching programs. This is a major goal of our Laboratory whose ultimate concern is the production of a comprehensive picture of early child development.